Symposium Proceedings

ROAD VERGES IN SCOTLAND

THEIR FUNCTION AND MANAGEMENT

Edited by,

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Edinburgh.

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The reasons why wildlife conservationists are concerned about roadside verges was probably sufficiently expressed at the London Symposium (Way, 1969), especially in the papers by Perring and Streeter, not to need repeating here. However, it has been suggested that the London Symposium was only really relevant to the lowland parts of England and that the situation in Scotland and Northern England might be rather different so far as wildlife was concerned.

As a generalisation this may be so and the reasons for any difference, apart from latitude and climate, would be of adjacent land use, of animal grazing and specifically of whether or not the highway was enclosed.

Now most of the highways in lowland Britain, except in some wooded areas or other special places such as commons, are enclosed or where the boundary hedges are being removed in arable areas, are not accessible to large wild or domestic herbivores. This would be as true for Wales and Scotland as for England so that in lowland parts of Scotland there is no reason to suppose that road verges are of any less actual or potential value as a wildlife habitat than in Southern England. In fact, in Scotland, because many species of plants may be nearing the norther limit of their range, the value could often be greater, particularly as the greatest density of roads is in just those lowland districts where these plants might be found. However, in upland regions of Britain, many roads are unenclosed and are grazed, mainly by sheep and deer. The proportion of these roads in Scotland is greater than in England. Thus, because a large part of Scotland is upland country where there are fewer roads, many of which are unenclosed, the overall conservation importance of the verges is different.

In upland, unenclosed, areas the growth of roadside vegetation rarely poses a problem to the highway authority, either because the plants themselves do not grow to an objectionable height, or because the verge is grazed. It is worth noting that whilst this holds good for verges that have not been disturbed by roadworks over a long period of time (where stable communities of mainly local, native plants have developed), in areas of *newly* established verges a regime of management of the sown grasses may be required. However, because of the enormous *acreage of* natural vegetation all around, it must be concluded from a wildlife point of view that the contribution of unenclosed road verges in upland areas to conservation will be very small. Any management for other than engineering or safety reasons is more likely to be for amenity, often on

an opportunity basis.

In both upland and lowland areas where the highway is enclosed, there will be a qualitative difference in the vegetation of the road verge compared to that of adjacent land. Furthermore, because the verges are not generally grazed, some form of management will be necessary. In order to maintain the characteristic wildlife habitat of grass verges, it is as important to manage them as it is for engineering reasons. No one would claim that all grass verges in isolation have any particular conservation value but as in England, because road verges are continuous and because of the difference in management from adjacent land, they do in aggregate have a considerable importance as a wildlife habitat and communications system. Some individual verges, where rare plants grow or where there is a particularly rich diversity of plants, do in themselves have importance. The interest of these verges is often a result of traditional forms of management over long periods of time, with the consequent development of more or less stable closed sward communities. In terms of numbers of different species of plants (diversity) in a given area, continuity of a particular form of management is usually necessary. This continuity of management allows the gradual build up of the many species that are in fact adapted to the particular conditions being created but most of which were not present in the beginning. Over a long period stable situations are sometimes, not always, established where there is a resistance to successional changes, as for instance from grassland to scrub. On the other hand, widely changing methods and intensity of management in a short period often lead to rapid successional changes because no one plant community has an opportunity to develop; a concomitant result of this is often poor diversity of species and low grade wildlife habitat. However, there is much to be said for having different management regimes in neighbouring places - thus on one verge a flail might be used once in the season, on another a cutter bar several times, on another a chemical growth retarder such as Maleic Hydrazide. In this way in adjacent areas a range of plant communities differing in detail might be built up over a period of time. In the less intensively managed parts of road verges (and other similar areas of land of 'secondary economic importance') there are also the successional plant communities characteristic of rotational forms of management such as scrub control, coppicing and so on. These in their place are equally desirable.

With new areas, such as motorway banks, a schedule of management regimes has to be evolved to take care of the rapid changes in the first few years after establishment from the sown species and the weedy species of disturbed ground to a more permanent community. There are great opportunities in these areas for a sequence of sowing and management programmes designed to encourage plant communities, that, once developed, can be relatively simply managed over a period of time to provide stable and diverse wildlife habitats which are acceptable in other ways to the landowner, authority or undertaking immediately concerned.

The use of chemicals to control vegetation in situations such as road verges has been viewed by plant and animal ecologists with a good deal of suspicion. This is largely based on the fact that the herbicides which are used, selectively kill plants or alter their competitive ability inaquite unnatural manner usually leading to a species poor community. Now all forms of management affect the competitive ability of plant specise in a community but cutting (as a management tool) is in many ways similar to grazing. A whole range of plants are adapted to grazing, and come together in time under this form of management to form the characteristic flora of pasture land. Similar communities develop in grassland subjected to cutting. Herbicides such as 2,4-D selectively kill broad-leaved plants and also appear to affect thegrowth of some grasses (see below and also Willis, this symposium) after some years of application, tending to produce a simple, species poor community in which herbs are generally absent. This is of course what herbicides are designed to do in agriculture, but in non-agricultural land this result would be considered bad by most ecologists and all conservationists. Nevertheless, in particular areas, usually of recently disturbed ground, where significant stands of injurious weeds (as defined by the Weeds Act 1959) are present adjacent to agricultural land, the use of a suitable selective herbicide to control them would be quite justified. A distinction must be made here between herbicides and the more specialised group of compounds known as Growth Inhibitors or Growth Retarders, of which Maleic Hydrazide (MH) is the only one generally available. MH affects the competitive ability of plants in a selective way, inhibits flowering and is especially effective on grasses. It does not, at the dose rates used, normally kill plants directly and because of its inhibiting effect on grass growth, often encourages the growth of herbs. Although the resulting swards do not always appear entirely natural, they can be species rich.

A great deal is written and said about weeds on road verges and highway authorities are under constant pressure to control them. Two classes of plants may be considered as weeds on road verges: (a) those that affect the highway and (b) those that affect the adjacent landowner, especially if he is a farmer. Generally speaking, plants in the first class are not agricultural weeds but are usually tall growing biennial or perennial plants that affect visibility and safety. Where these plants grow on straight roads, on the outside of bends, or in other places where they do not cause an obstruction, they can scarcely be classed as weeds and there is no justification on this count for their destruction. Many of them, especially the Umbellifers such as Cow Parsley (Anthriscus sylvestris), Cow Parsnip or Hogweed (Heracleum sphondylium) and Sweet Cicely (Myrrhis odorata), and the Composites, Hardheads (Centaurea nigra) and Field Scabious (Knautia arvensis) are extremely valuable for wild insects and the birds that feed on them. Agricultural weeds can be basically divided into those aggressive annual species of plants which together with a number of rhizomatous grasses make up the bulk of the weeds of cultivated ground, or into plants of natural grassland which,

when they occur in pastures, become weeds. On the whole, well managed leys are substantially weed free, because the grass sward is sufficiently tight to exclude casual introduction of weedy plants. So far as pastures are concerned, management is paramount in weed control. No amount of destruction of weed species in neighbouring areas (such as road verges) will affect the degree of infestation of a pasture that is inherently weedy because of the level of weed seeds in the soil; or a pasture that is overgrazed, or under fertilised, or even one that is badly undergrazed. Weeds of cultivated ground (e.g. frequently disturbed ground) are not characteristic plants of closed community grass swards on undisturbed ground, such as road verges may generally be considered to be. The test of this is to go and look at any established road verge and see how many of the weeds occuring in adjacent cultivated ground also occur on the verge. If there are any, to consider how many of the weedy plants there are in the verge compared to the field, and the significance of the seed being dropped in the soil of the field by the weeds already there compared to any that might be transported from the verge. Couch grass (Agropyron repens) is a special case often specifically mentioned. The plant occurs on road verges and seeds there, but the seed is heavy and not windborne; it seems unlikely that it would be eaten and pass undigested through the gut of the birds to be spread in that way. The principle method of spread by this plant is in any case by the well known underground rhizomes, but no amount of cutting will prevent their spread although it does appear (see below) that some cutting treatment will reduce the density of above ground shoots. In general the management techniques practicable on the majority of road verges will not prevent the plant from spreading so there is no reason to apply management to control it specifically. Wild oat (Avena fatua) is rarely found on road verges and when it is, can be assumed to have spread there from a neighbouring field. It is true that when verges have been newly established, or disturbed by roadworks or farm machinery, or in some other way, they will so long as they are disturbed, support a flora containing populations of weedy plants. There is no doubt these should be controlled; if necessary by the use of herbicides, if a real danger of spread into adjacent clean land seems likely. In general, although farmers' concern for the presence of plants on verges as potential sources of weeds on their land really is appreciated, it is probable that this concern is often out of all proportion to the actual hazard. In many instances, the plants complained of are not agricultural weeds of economic status and in some instances do not occur in cultivated land at all.

MANAGEMENT EXPERIMENTS

Country Roads

The two experiments in Huntingdonshire and Cambridgeshire reported on at the London Symposium (Way, 1969A) were continued in 1969 for the fifth year in succession. The treatments are shown in Table 1, where it should be noted that treatment 19 was sprayed with MH (as treatment 3) for the first time, and that treatment 20 was sprayed with MH and subsequently cut in June (as treatment 4) for the first time in 1969. These

TABLE 1

Treatments applied to experimental plots on road verges in *Cambridgeshire and Huntingdonshire.*

		Operation in third week of:					
		April	May	June	July	August	September
1.	Untreated						
2.	Untreated						
3.	Maleic hydrazide	spray					
4.	Maleic hydrazide and cut later	spray		cut			
5.	Maleic hydrazide and 2,4-D	spray					
6.	Maleic hydrazide and 2,4-D; cut later	spray		cut			
7.	2,4-D	spray					
8.	2,4-D and cut later	spray		cut			
9.	Flail twice		cut			cut	
10.	Flail five times		cut	cut	cut	cut	cut
11.	Haymower twice, cuttings raked		cut			cut	
12.	Haymower 5 times, cuttings raked		cut	cut	cut	cut	cut
13.	Haymower twice, cuttings NOT raked		cut			cut	
14.	Haymower five times, cuttings NOT raked		cut	cut	cut	cut	cut
15.	Rotary mower twice		cut			cut	
16.	Rotary mower five times		cut	cut	cut	cut	cut
17.	Haymower once			cut			
18.	Haymower once				cut		
19.	Maleic hydrazide	spray					
20.	Maleic hydrazide and cut later	spray		cut			

two treatments are thus not comparable with the others in terms of age. In treatments 3, 4, 19 and 20, and also in treatments 5 and 6, MH was applied at 5 lb/ac a.i. as Regulox 36 W; in treatments 7 and 8, 2,4-D was applied at 5 lb/ac a.e. as Vergemaster but in the combined spray treatments (5 and 6) at 3.5 lb/ac a.e. In all cases the sprays were applied at 80 gallons per acre and 30 p.s.i. The flail mowers were in both cases side mounted Lupat machines; the rotary mower was a small hand propelled garden machine and the haymowers were of the conventional tractor mounted reciprocating cutter bar type.

The height of the vegetation was measured at monthly intervals from May to September, colour photographs of the plots were taken and records were made of the plants in flower on each occasion in each plot. Presence/absence records of plants in forty 15 cm quadrants per plot were made in July/August.

The numbers of species of plants that flowered in each treatment are shown in Table 2.

In terms of diversity (i.e. numbers of species of different plants) the only clear cut effect was that of 2,4-D which reduced it. However, it is of interest that there was probably a greater reduction from 2,4-D at 5 lb/ac (7 and 8) at Keyston (Huntingdonshire), and possibly also at Ickleton (Cambridgeshire), than from 2,4-D at 3.5 lb/ac when mixed with MH (5 and 6). This Table only tells part of the story as it is based on any record of a plant in flower, whilst in fact one plot might be a mass of inflorescenses of a given species and another plot might have one flower only. A similar analysis of the total number of species recorded per treatment, regardless of whether they flowered or not, did not show any consistent pattern of effect except where 2,4-D had been used and there was a reduction in the number of species.

Results of the quadrat counts are beginning to show some patterns of effect on individual species but these are still too variable to describe in detail. The effects of MH on vegetation over a period of years are described by Willis (this Symposium) for a site in Gloucestershire and essentially similar results are being recorded in my trials. With 2,4-D and the mixed spray of the two compounds, differences in detail are also apparent, both in relation to time (i.e. changes reported by Willis in his trial to have occurred in 4 seasons are still not consistently apparent after 5 seasons in trials here) and to effects on species composition, attributable to site differences. Of the three machines, the haymower produces a less even cut and does not cut so close as the other two machines, which in the hands of an unskilled or tired operator can damage the sward. Both of these machines (flail and rotary cutter) should be fitted with jockey wheels or rollers to prevent them from cutting too close to the ground. In general terms the effects of cutting in May and September (treatments 9, 11, 13 and 15) or in June (treatment 17) are on

TABLE 2

Total number of species of plants flowering during 1969 for each treatment in experiments in Cambridgeshire and Huntingdonshire

Treatment number	Treatment	ICKLETON Cambridgeshire Site			KEYSTON Huntingdonshire Site		
		Herbs	Grasses	Total	Herbs	Grasses	Total
1	Untreated	29	9	38	19	13	32
2	Untreated	29	8	37	22	11	33
3	MH	29	6	35	26	10	36
4	MH + Cut	28	7	35	24	7	31
5	MH + 2,4-D	17	6	23	21	11	32
6	MH + 2,4-D + Cut	12	6	18	16	8	24
7	2,4-D	8	9	17	4	13	17
8	2,4-D + Cut	12	7	19	5	11	16
9	Flail x 2	28	8	36	26	10	36
10	Flail x 5	30	7	37	19	11	30
11	Haymower x 2 Raked	31	9	40	24	13	37
12	Haymower x 5 Raked	30	6	36	27	8	35
13	Haymower x 2 not raked	27	9	36	23	12	35
14	Haymower x 5 not raked	30	7	37	25	10	35
15	Rotary mower x 2	31	9	40	19	12	31
16	Rotary mower x 5	24	8	32	25	10	35
17	June only	27	8	35	21	8	29
18	July only	33	10	43	19	13	32
19	MH	30	11	41	25	7	32
20	MH + Cut	25	7	32	26	12	38

the one hand to allow the later summer flowering plants to develop and on the other, to allow spring flowering plants. A further advantage of the June cut is to allow ground nesting birds such as Duck, Partridge, Pheasant, Yellow Hammer, Reed Bunting and others to get their first brood off. However, if the first cut is delayed until June, a somewhat coarser vegetation does develop than if the first cut is in May and the cuttings left by the machine are heavier, in themselves tending to supress smaller plants and favour the more vigorous. If the first cut is delayed until July (treatment 18) a generally much coarser vegetation develops. Frequent cutting (treatments 10, 12, 14, 16) leads to a finer vegetation, with gradual disappearance of Couch (Agropyron repens) and False Oat (Arrhenatherum elatius) but not apparently Cocksfoot (Dactylis glomerata). Increases in Bent grass (Agrostis stolonifera) have been recorded in these plots together with a number of low growing herbs such as Creeping Buttercup (Ranunculus repens), Birdsfoot Trefoil (Lotus corniculatus), White Clover (Trifolium repens), Hop Trefoil (Trifolium campestre) and Germander Speedwell (Veronica chamaedrys). The plots that have been uncut for 5 years (treatments 1 and 2) have developed a coarse vegetation of tall growing grasses and herbs, though not necessarily of weedy species, and also occasional shrubs mainly hawthorn.

The mean height of vegetation in selected treatments at intervals during 1969 are shown in figures 1 and 2.

From these some practical generalisation can be made remembering that the results are from the east Midlands of England.

a) Cutting 5 times at monthly intervals with any of the machines will maintain vegetation below a height of 12 in.. It is probable that this could be achieved by two, or at the most three cuts, at monthly intervals beginning in May (see also fig. 3).

b) If the vegetation has to be less than 6 in., more frequent cutting will be necessary, probably beginning in April and continuing at 3 weekly intervals into June, after which longer intervals may be possible (see also fig. 4).

c) Cutting once in June or July will prevent the vegetation generally exceeding 10 in., for the remainder of the season but for a period from the end of May to the time of cut, increasingly tall vegetation will have to be tolerated.

d) A single cut in May with a haymower will have the same effect as a single application of MH in April, the average height of the vegetation in July reaching 12 - 14 in., (figs. 1 and 2).

e) A combination spray of MH and 2,4-D in April may lead to a

Fig. 1 Mean height of vegetation in selected treatments sprayed with MH, 2,4-d or a combination, on 3rd May, with and without a later cut in June. Cambridgeshire 1969.

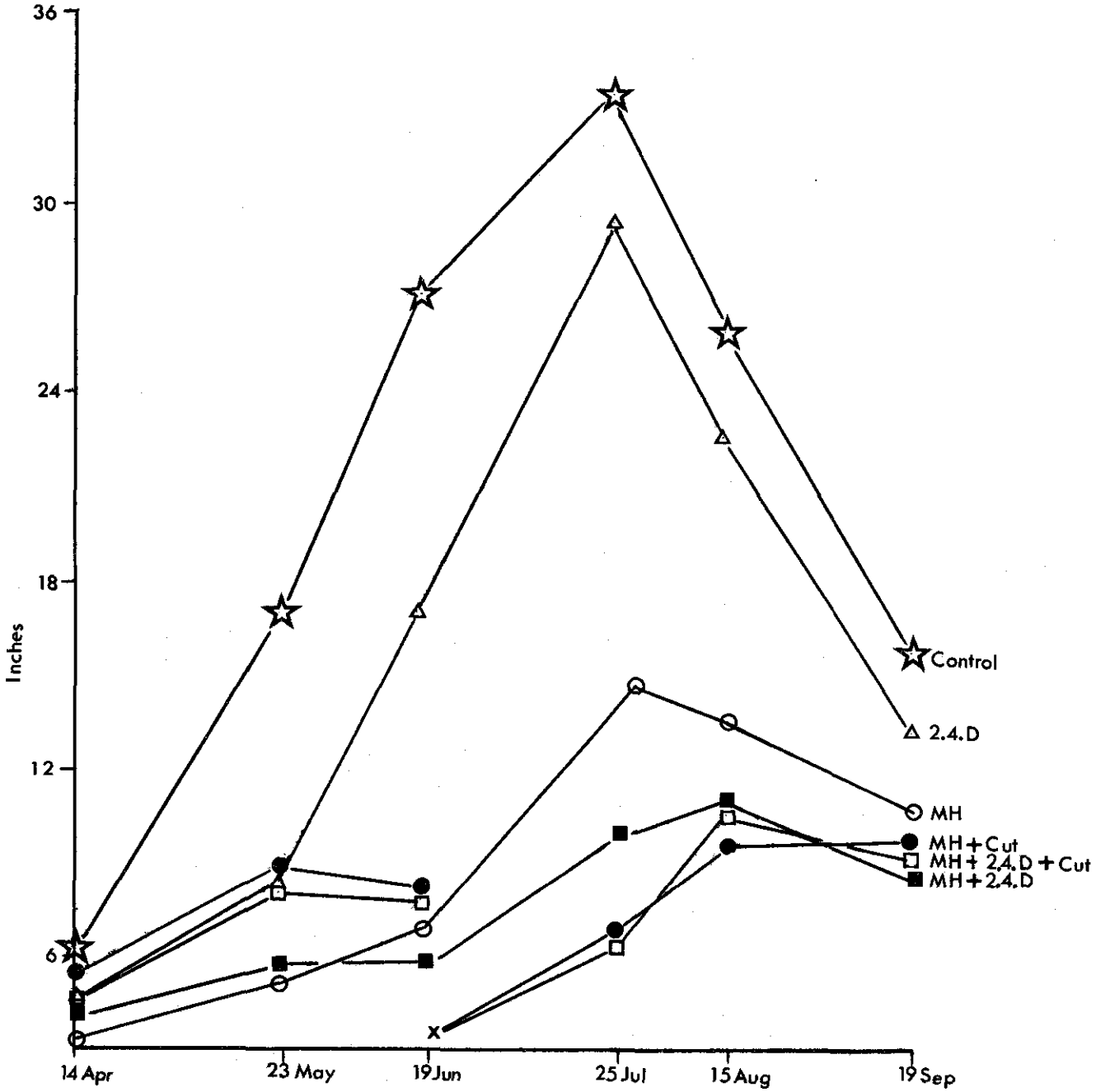
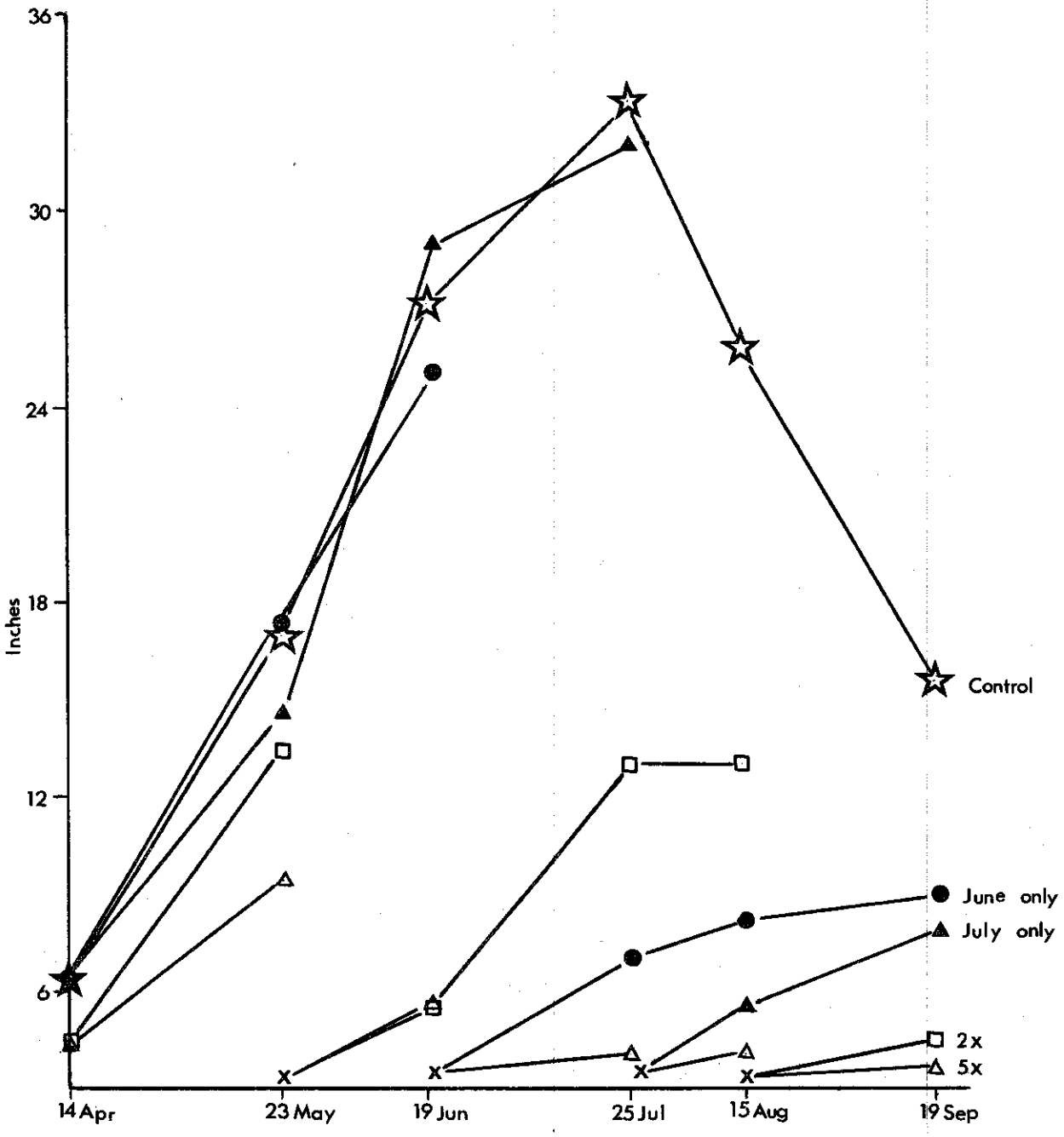


Fig. 2 Mean height of vegetation in selected treatments cut with a haymower and the cuttings raked off. Cambridgeshire 1969.



shorter vegetation than this with an average height of 10 - 11 in., in July. This would be analagous to two cuts with a haymower, one in May and the other in June (figs. 1 and 3).

f) A single spray with 2,4-D in April may reduce the height of vegetation compared to uncut plots in July but not apparently before or after. The advantage of this is dubious and some of the ecological drawbacks of the use of 2,4-D have been pointed out earlier in this paper.

g) Cutting plots six to eight weeks after spraying with MH or MH + 2,4-D will maintain vegetation at an average height of less than 12 in., through the season and is essentially comparable to two cuts, one in May and the other in June.

h) Cutting plots six to eight weeks after spraying with 2,4-D will give a pattern of rather tall vegetation up to the time of cut, and thereafter similar effects on height to a single cut in June.

Motorways

As mentioned above, there are very considerable opportunities for creating wildlife habitats, protected from the public, on the verges, banks and cuttings of motorways. A preliminary experiment to see what management schedules might be appropriate was described at the London Symposium (Way, op. cit) and was continued in 1969 for the second year. It is too early in the life of this experiment yet to give any detailed results on the vegetation except in relation to height. The results of measurements of height in two of the treatments (cutting in May and June, and cutting in April, May, June, July and September) are shown in figs. 3 and 4. The essential conclusions from these have been discussed above.

General

It has been a common policy with many Councils in the past year or so, to maintain the front of the verge next to the road to a higher standard than the back of the verge. From a wildlife point of view this is excellent as it leads to a range of different habitats and encourages diversity of plant and animal species. In this respect the interests of wildlife conservationists and of Highway Authorities may well be the same, although for different reasons. In fact, in very broad verges it is hoped that a 'multi-zone' system of management could be applied by County Authorities with the intensity of management falling off in zones as one goes further back from the road itself.

From a botanical standpoint it is worth noting that the tall growth of grasses comes from the flowering stem (or culm) and that once this is

Fig. 3 Mean height of vegetation cut in May and June. M.1 Motorway 1969.

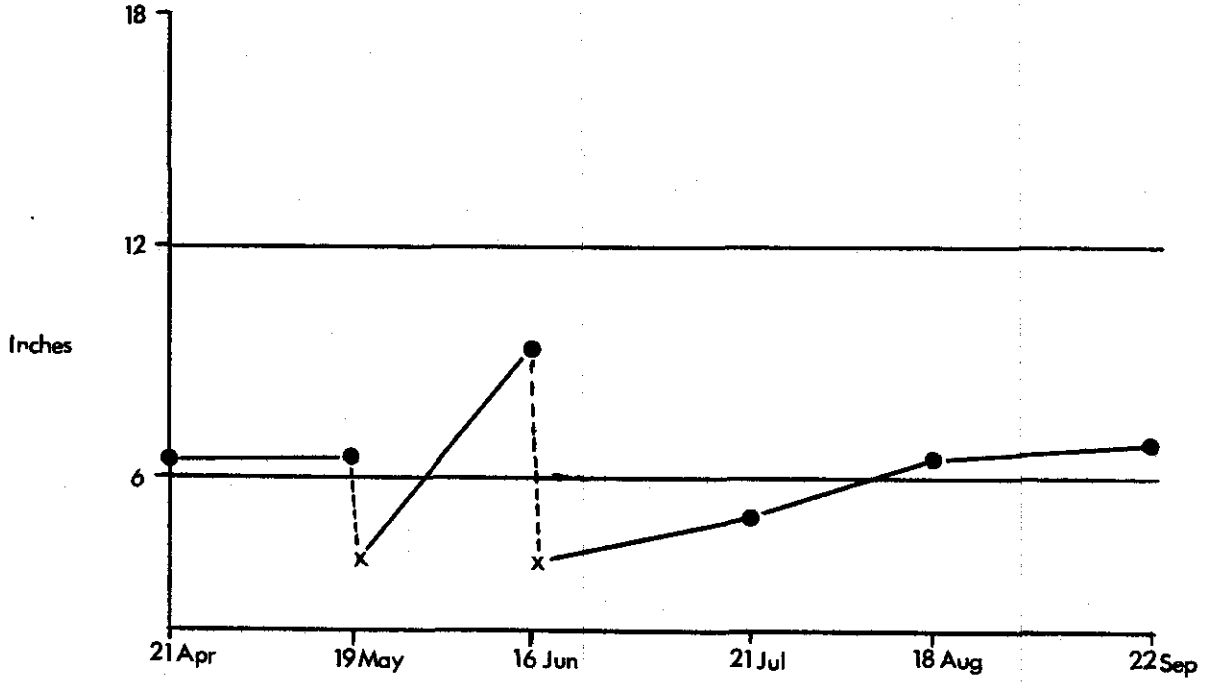
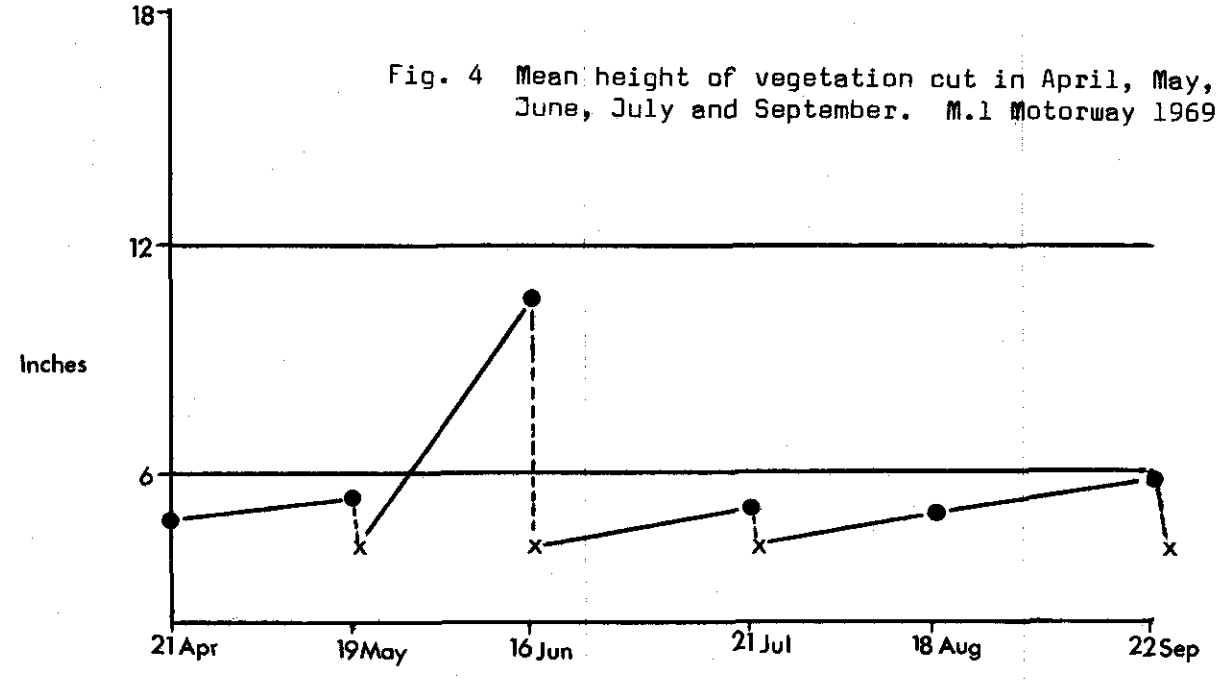


Fig. 4 Mean height of vegetation cut in April, May, June, July and September. M.1 Motorway 1969



cut off after a certain period of the year it is not normally replaced. The part of the plant left is almost entirely leaf produced from organs of the plant at soil level and only in a few grasses are the leaves longer than 12 in., although a number of roadside grasses do have leaves longer than this. The choice of an acceptable height of vegetation is therefore fairly critical, because, if it is possible to control the culm growth either by use of MH or by cutting, subsequent growth of leaves of the majority of grasses in unlikely to provide a road hazard. However, if a height of 6 in., is prescribed, then not only must the culm growth be controlled but also growth of leaves.

Conclusion

In the low lying land of Scotland, where the highways are enclosed, the importance of road verges as a habitat for wildlife may often be as great as in the comparable parts of southern England. With the intensification of agriculture and particularly with an increase in the use of herbicides in grassland, road verges have an importance as relict areas of natural grassland. Enclosed highway verges rarely nowadays have any economic value for hay or grazing and in fact their maintenance is a continual unproductive drain on general highway funds. Their conservation value for wildlife is not assessable in money terms and does not often reside in individual stretches. However, it can be assumed that in the aggregate, they do have an importance, and in many instances forms of management that will favour diversity of species and structure of habitat for wildlife will be less rather than more expensive to the Highway Authority.

ACKNOWLEDGEMENTS

It is again a pleasure to acknowledge the interest and help of the Cambridge and Isle of Ely, theHuntingdon and Peterborough and the Leicestershire County Councils, together with the Ministry of Transport, with whose co-operation the experiments referred to in this paper are being made. Also Mr. V.F. Woodham of Burt, Boulton and Haywood, Limited, through whom the chemicals were supplied and by whom they were applied.

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CONSERVATION OF ROADSIDE VERGES IN SCOTLAND

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For the Symposium on "Road Verges - Their Function and Management", held in London in March, 1969, Mr. D.T. Streeter produced a paper entitled "Road Verges - A Local Responsibility for Conservation" (Streeter, 1969), in which he cited the County Nature Conservation Trusts as suitable bodies to undertake the care and conservation of road verges and gave many instances to show how the Trusts were indeed thoroughly involved. The place in nature conservation filled by the County Trusts in England and Wales is occupied in Scotland by the Scottish Wildlife Trust which is similar in constitution and in its mode of operation but national in scope. A series of papers on road verges in Scotland would not be complete without a report on the work and experience in this field of the Scottish Wildlife Trust, which this present paper will offer. Mr. Streeter did in fact note the work of the Scottish Wildlife Trust in his original paper but the mention was naturally a brief one.

The Scottish Wildlife Trust became concerned with roadside verges in 1967, when a paper was submitted to the County Surveyors' Society (Scottish Branch) by the author of this present paper in his capacity of Trust Secretary. The lines of this first approach to the conservation of roadside verges in Scotland benefited from experience gained by County Trusts in England and Wales. This was made freely available by the County Trusts through the County Naturalists' Trusts Committee of the Society for the Promotion of Nature Reserves. This help is gratefully acknowledged by the Scottish Wildlife Trust. However, despite the importation of experience, there were important differences encountered in implementation and these are brought out in the present paper for consideration by the Symposium in Scotland.

The paper produced in 1967 was accepted by the County Surveyors' Society whose Hon. Secretary reported a general agreement by members of the Society that "if the Trust would designate particular stretches of roadside verge for special treatment they would co-operate to the best of their ability". In discussion between the Society and the Trust, it was however made known that County Surveyors in Scotland were working under the provisions of an old enactment, the Roads and Bridges (Scotland) Act 1878, which laid apparently heavy responsibilities on road authorities. Thus, under Section 106 of the Act, it was stated that "the trustees of every turnpike road shall cut or shall cause to be cut all weeds growing on the same or sides thereof, when enclosed, at a proper season of the year, in order to prevent such weeds coming into seed" Unfortunately the legislation lacked any definition of "weed" and the

possibility of very many species of plants earning this designation in the eyes of one body or another made the obligation look possibly an open ended one. It was pointed out by the Trust that the sections of verge which carried plants of interest to the Trust would usually be long-established ones and they were unlikely to contain the common weeds which were characteristic of recently disturbed ground. It was agreed that the Trust would be responsible for meeting with third parties who were concerned about the possible spreading of weed species from designated verges and this responsibility was subsequently conveyed to the Branches of the Trust.

The Trust in Scotland operates through regional Branches which are semi-autonomous though guided and advised by the Trust. This situation compares closely with England and Wales where the County Trusts are fully autonomous but are advised and guided by the Society for the Promotion of Nature Reserves. The Branches were encouraged to set up programmes for verge conservation, according to their resources and other commitments, and within the provisions of the agreement reached with the County Surveyors' Society. Four, out of eight Branches, started programmes and by the end of 1969, 5 counties had been dealt with, though one of them, Perthshire, was only half completed. The following information therefore represents only a beginning to verge conservation on a national scale. Nevertheless some useful experience has been gained. Particularly is it interesting to see how the botanists within the Branches have interpreted the instruction from the Trust "to safeguard uncommon or interesting plants or interesting communities of plants occurring in the verges of roads of all categories."

Some 50 verge sections have been designated - 13 in Berwickshire, 16 in the three Lothian Counties, 16 in Perthshire and 4 in Orkney, but further sections are likely to be added in all these counties. More than 40 sections protected single species, of which 21 were either rare in Scotland or locally uncommon and 12 were naturalised or had been introduced to Scotland and were at the same time rare; the remaining few sections covered relatively common species which were occurring in conspicuous masses. Among the rare species are Sambucus ebulus (Danewort) in Perthshire and Silaum silaus (Pepper Saxifrage) in East Lothian; locally uncommon species are Geranium pratense (Meadow Cranesbill) in East Lothian and Plantago media (Hoary Plantain) in Berwickshire. Naturalised and introduced species include Geranium phaeum (Dusky Cranesbill) in East Lothian and Rumex alpinus and Geum macrophyllum in Perthshire. In Orkney, where the floristic range is much reduced, Ononis repens (Rest Harrow), Stellaria holostea (Greater Stitchwort) and Galium mollugo ssp. mollugo (Great Hedge Bedstraw), have been selected for safeguarding.

The instruction to select uncommon species has clearly been applied

in the field, while the pursuit of interest has been an added reason for the inclusion of a number of naturalisations and introductions. Some additional information supporting the claim to interest is offered, as an example, for Rumex alpinus (Monk's Rhubarb) which was introduced to Perthshire from East Central Europe, probably by monks; its leaves were used for wrapping butter. The presence of non-indigenous species does suggest that roadside verges containing them have been disturbed in the recent past and are not truly ancient.

Dr. F.H. Perring, writing on "The Botanical Importance of Roadside Verges" for the earlier Symposium (Perring, 1969), stressed the importance of road verges as relics of native grassland. Communities of plants have been safeguarded in 7 sections of verge under the present programme in Scotland, and in each case an example of a natural community is represented. In most instances the communities occupy a base-rich site. Examples are a grassland/herb community, comprising Potentilla argentea (Hoary Cinquefoil), Dianthus deltoides (Maiden Pink), Trifolium striatum (Soft Trefoil) and Saxifraga granulata (Meadow Saxifrage) in East Lothian, and Epipactis helleborine (Broad Helleborine) with short grasses, in Perthshire.

Amenity has been well served by these programmes as all but a few of the safeguarded species are attractive and most are distinctly showy, though only in 6 instances were verges primarily selected for a showy plant which was appreciated to be common. The counties which have attracted programmes have all been lowland and the programmes have even there concentrated on the agriculturally most developed portions. In such portions the lack of plants of the same species in farmland away from the verge has made the verge sections uniquely important. Extending this experience to other parts of Scotland, it is unlikely that moorland regions will call for much attention under the verge conservation scheme since verges and adjacent moorland, often in the absence of any dividing fence or barrier, are subjected to the same influences and the same plants are likely to occur overall.

Questions raised by farmers in Perthshire were resolved by discussion between the county Branch of the Trust and the Perthshire committee of the National Farmers Union, so that the roadside verge programme proceded with the blessing of agricultural interests.

Branches have accepted responsibility for designation, recording, notification and demarcation of verge sections. Sections are first described and then marked on two copies of a 1" road map. One copy is handed to the County Surveyor in the spring of the year and recovered in the autumn for revision. It is also the function of the Trust to mark verge sections on the ground. Wooden posts, painted white and marked with distinctive initials, are placed at each end of a section.

One County Surveyor has kindly supplied posts but normally they have been provided by the Trust. Posts are 4' 6" long and have a cross-section of $1\frac{1}{2}$ inches square. Driven into the ground as far as they will penetrate, by means of a mallet, they are unfortunately too easily removed by passers by. Such losses are serious because much time and effort, given by experts, is negatived and re-location requires special journeys.

There has been too little time for management of verges to have become sophisticated. A rule of thumb has been established which delays cutting of vegetation till after August but clearly this will not suffice for all verges except as an interim measure; some species of plants might benefit from the mowing of verges during the growing season if this would check the development of more aggressive species. It is unlikely in the long term that any common management policy will suit all verges; not only do the requirements of species vary but roads attended by verges include all categories from the A9 Trunk Road to unclassified roads and road safety requirements vary with the category. It has been arranged that verge marking posts are placed close to the rear boundary of all verges and not less than 4 feet from the edge of the carriageway, thus facilitating the taking of a 3 feet wide cut when this becomes necessary. Verges selected at the current density have given rise to conflict between conservation and road safety in only two cases, both in East Lothian, during the last 2 years. In one case the verge was seriously but unavoidably damaged during road widening at an intersection but a similar operation at the second site was carried through without loss of plants, these having been marked off with temporary ropes throughout the operation. In this case the fact that an interest in the plants of the verge had been established, was all-important. The occasional failure of an employee to notice a safeguarded verge, which has resulted in the verge being mown at the wrong time, has been reported but not on any occasion has herbicide been applied to a designated verge.

Some recommendations are made for consideration for the future:-

(i) County Surveyors' staff should become more closely involved in the safeguarding of verges. Local members of staff should "take-over" the verges after they have been designated and should "hand-over" information about them to their successors.

(ii) A more permanent marker than the wooden post is desirable. A concrete pillar would be preferable. County Surveyors are asked to consider making such pillars available and to be responsible for putting them in position.

(iii) Trust members should work out and recommend the appropriate form of management for each safeguarded section.

(iv) The safeguarded verge programme might be applied more widely to cover also verges containing plants which are primarily attractive and secondarily of scientific interest, thus safeguarding also amenity.

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THE FARMER AND THE ROADSIDE VERGE

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From the Arable Farmers' point of view roadside verges and hedges are a complete nuisance, being a harbour for weeds and dirt in all forms, including couch grass or rack (as it is called in Scotland), the bane of modern farming.

Rack and much else is spread outwards into the fields, by the practice of ploughing out the hedge-backs.

Stock farmers are, apparently, no more enamoured of the roadside verge either! Busy roads have put an end, largely, to stock grazing the verges, or the "long meadow", as the Irish call it, and, in fact, where roads are unfenced and verges are re-seeded, the fresh grass attracts animals, causing many of them to be killed and creating a road hazard to motorists.

So, from the purely agricultural view point, most farmers (assuming they are being entirely businesslike) would wish to see fenced roads, hedges removed, and a "scorched earth" policy employed on the verges.

However, it is recognised that other interests are involved, and coupled with cost factors we are not likely to reach the ideal state outlined above.

Nevertheless, a statement of the problems involved, particularly when we have the ear of the Local Authorities may help to "clear the air" and help towards the creation of roadside verges acceptable to all parties involved.

Information on this topic was asked for and received from the National Farmers' Union Area Secretaries all over Scotland. Their replies revealed quite a variety of opinions and problems.

Firstly, there is the obvious problem of weed control, the uncut or untreated verge. In fairness it must be said that a few Areas are broadly quite satisfied with existing arrangements. The Local Authorities apparently co-operate well, and they state they have few problems. Weed control here, takes the form of cutting the verge with a reaper or a flail-mower.

Some N.F.U. Areas are unhappy about the cutting. They consider it is done too late, when the weeds have flowered, and also an uncut strip is left near the hedge.

This raises the questions:-

(a) who owns or is responsible for this part?

(b) does the Highway Authority only have an obligation to cut enough of the verge to ensure good visibility, and thus reduce a road hazard?

One Area considered uncut verges were causing accidents, while a number of others considered weed control was inadequate.

Secondly, there is the problem of road drainage, which is a two-fold one, as far as the farmer is concerned. Namely:-

(a) The draining of surplus road water into adjoining fields and

(b) the lack of maintenance of roadside ditches.

It is realised that under the Roads and Bridges Act (1878), the Local Authorities are entitled to run drain water into nearby fields, and it may be, though I am not able to verify this at the moment, that farmers are responsible for open drains and ditches.

Here, I think, a revision of this Act is overdue. Some of its provisions must be rendered obsolete by the growth of modern traffic.

One Area has pointed out that hidden drains and overgrown ditches have caused major accidents, which on level verges might have been relatively minor. It ought to be the responsibility of the Local Authority to pipe and close these ditches as this benefits the road using public and not the farmer. With regard to surface water, it should be made statutory for the Road Authority to ensure that it is properly led into the nearest field drain.

Many Areas express anxiety on this drainage problem, particularly with regard to made-up or re-aligned roads which increase the catchment areas.

Finally, there is the problem of the width of roadside verges.

With regard to unfenced roads, Stirling Area brought up the point that the Roads and Bridges Act 1878 stipulates that a margin of 12 ft. be retained, unploughed, between the field and the Public Highway, where the fields are unfenced. It is felt that this margin is drastic, under modern conditions, and ought to be amended.

On the stock side, as mentioned at the beginning of the paper, two upland Areas stress the danger of reseeded verges attracting animals and often resulting in their deaths. They feel that at least, trunk road fencing ought to be considered.

On the point concerning width of roadside verges, some Areas felt that there was much waste of land here, particularly new verges at road junctions.

A contrary view was expressed by one Area, who felt wider verges were of benefit, as snow clearance did not then tend to damage the fence.

Another Area put the view that although land was wasted, it was felt that it was better for the ground to be taken at one time rather than that it should be taken in small parts, each time further widening of the roads became necessary.

In conclusion I would like to make some general points.

Firstly, I think the Roads and Bridges Act 1878 is in need of overhaul along the lines suggested.

Secondly, it is evident that much has been and could be achieved, with a closer co-operation between N.F.U. Areas and Local Authorities. Some Areas express their appreciation of efforts by their Local Authorities and seem to be satisfied with the results.

Nevertheless, many genuine points have been raised, which will require to be looked at, if a satisfactory working arrangement is to be achieved.

Thirdly, there is the reconciliation of the Wild life interests. I do not wish to trespass into the domain of the next paper, but a reading of the London Symposium papers impressed upon me the possibilities of sprays. I was particularly interested in the use of growth inhibitors coupled with selective weed killers, which seemed to produce a short grassy sward, fairly free of weeds.

Again, of course, cost is a paramount consideration, but it may well be a most promising method of controlling the verges, without greatly affecting wildlife.

I would disagree that only a 6 ft. wide strip need be done, there is still the problem strip next the fence or hedge. I would contend that the Local Authorities have some obligation towards keeping the whole verge tidy.

Under the Civic Amenities Act they are charged with the task of cleaning up the countryside as far as the dumping of rubbish is concerned!

It is surely only a logical extension of Government thinking on this matter to ask that road verges be kept trim and tidy.

THE LAW ON INJURIOUS WEEDS

Legislation on injurious weeds dates from the Corn Production Acts of 1917 and 1920 and further provisions were introduced under a number of subsequent Acts. In July 1959 the previous enactments were repealed and all the provisions consolidated in the Weeds Act, 1959. The injurious weeds to which the Weeds Act applies are:

Cirsium vulgare	(spear thistle)
Cirsium arvense	(creeping or field thistle)
Rumex crispus	(curled dock)
Rumex obtusifolius	(broad-leaved dock)
Senecio jacobaea	(ragwort)

and additional weeds may be prescribed by regulations.

The Minister has power under the Act to serve notice on an occupier of land requiring him, within the time specified in the notice, to take such action as may be necessary to prevent the injurious weeds from spreading. An occupier who unreasonably fails to comply with the requirements of such a notice is liable, on summary conviction, to a fine not exceeding £75, or for a second or subsequent offence, not exceeding £150; the Minister may also enter on the land and take the necessary action to prevent the weeds from spreading, recovering the cost of doing so from the occupier.

Since 1939, there have been changes in the delegation of the Minister's powers. At present the councils of county boroughs exercise the delegated powers on non-agricultural land within their areas, the Minister's divisional executive officers the powers on non-agricultural land outside the county boroughs, and the county agricultural executive committees on agricultural land within their areas.

From the WEED CONTROL HANDBOOK, 5th edition 1968, Eds. J. D. Fryer & S. A. Evans, Volume 1 (Principles). Blackwell Scientific Publications, Oxford and Edinburgh. With acknowledgments.

THE USE OF CHEMICALS IN THE MANAGEMENT OF VEGETATION: LONG-TERM STUDIES OF THE EFFECTS OF SPRAY TREATMENTS

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INTRODUCTION

Two major aspects of the management of roadside verges concern the control of height and of the composition of the vegetation. The unimpeded visibility required by the road-user necessitates a short sward, especially immediately adjacent to the road, and it is desirable to eliminate weed species, particularly those troublesome in agriculture. Amenity considerations and the requirements of the motorist point to the need for an attractive but short roadside vegetation.

Chemical methods of control are now available which take the place of traditional cutting procedures; the work of the lengthsman can now be effectively and economically achieved by chemical spray techniques. The height of vegetation can be controlled by means of growth retarders or regulators and its composition altered by the use of herbicides. A combination of the growth retarder maleic hydrazide (MH) and the well-known selective herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) is proving especially valuable in the management of the vegetation of roadside verges; a single application of the mixed spray (MH + 2,4-D) annually in spring leads to the production of a grassy sward which is largely free from weeds and which remains conveniently short throughout the year.

While much is known about the effects of spraying over short periods, little information is available concerning the effects on vegetation when applications are continued over a substantial number of years. The ecological importance of the initial effects of the spray and more especially of the sequence of gradual changes which may result from spray application over a long period is far-reaching; a different community structure may develop highly contrasting with that of the semi-natural vegetation present initially. The roadside verge, with its range of conditions including those of the ditch and hedge, is a diverse habitat, supporting a great variety of plant life, both native and introduced, and it includes a substantial proportion of rare species (Perring, 1969). Modification of the structure of this vegetation by any method of management consequently raises issues of nature conservation. Information is needed concerning the degree of permanence of new community structures generated by spraying, and the extent to which re-establishment of the original type of vegetation (reversion) can occur on cessation of spray treatments.

Records bearing on these aspects, as well as on the effects on vegetation of time of spraying, have been made from a detailed study of the vegetation of an experimental area of wide verges near Bibury in Gloucestershire. Closely controlled spraying has been undertaken in this site over a period of twelve years, and records of a series of plots sprayed with growth retarder (MH) only, selective herbicide (2,4-D) only, and a mixture of these two substances (MH + 2,4-D) have been made in considerable detail from 1958 to the present. Accounts of previous observations are available (Yemm and Willis, 1962; Willis and Yemm, 1966; Willis, 1969), but the salient features are indicated here together with an outline of the most important results stemming from studies made in 1969.

Experimental Procedure

A sequence of 28 plots, each about 22 yd long and 3-5 yd wide, was established in fairly uniform vegetation developed on the Oolite of the Cotswolds along the wide verge of Akeman Street, near Bibury, Gloucestershire. Records were made once a year (in July) or three times annually (spring, summer and autumn) of height and flowering, and subjective assessments were made of the relative bulk of the different components of the vegetation of the whole plots, and of quadrats permanently marked within them (Yemm and Willis, 1962).

Eight plots which were not sprayed served as controls; the remaining plots were sprayed with MH only, 2,4-D only or MH + 2,4-D once a year in early April, mid-April or early May. After treatment successively for four years (1958-61), certain plots were not subsequently sprayed for a period of years so that the rate of reversion of the vegetation could be studied. To provide information concerning rates of change, two plots which had not received spray treatments for seven successive years, and whose vegetation was then very similar to that of the original control plots, were sprayed with 2,4-D only in the autumn 1968, and then with MH only in mid-April 1969. In addition, three plots which had reverted (no spray) for seven years were given a mixed spray of MH + 2,4-D in mid-April 1969.

Commercial preparations of MH ('Regulox W') and 2,4-D ('Vergemaster') were used. MH was applied as a dilute spray containing 5 lb MH in the form of the amine salt in 80 gal water/acre, and 2,4-D was applied as an acid-in-oil emulsion of the oil-in-water type at 3 gal (of 12.5% wt/vol 2,4-D) in 80 gal water/acre (c. $1\frac{1}{4}$ miles of a 6 ft width of verge). The combined MH + 2,4-D spray was a mixture of the two preparations at the rates given. For spraying, a boom with cone-type nozzles for high volume application at low pressure was employed.

The vegetation of the verges

In the experimental site the vegetation of the untreated verges normally forms a fairly complete cover and is dominated by coarse grasses and tall herbaceous plants such as the Umbellifers, Hogweed (Heracleum sphondylium) and Cow Parsley (Anthriscus sylvestris). The composition of this vegetation varies somewhat from year to year, dependent largely on seasonal conditions, and generally grasses and broad-leaved plants contribute about equally to the bulk of the vegetation. The dominant plants all flower freely, giving a vegetation of average height of about 3 ft in July. In 1969 the average height was greater than this (Table 1), due largely to the vigorous growth of the Umbellifers that year (in July 1969 the fruiting heads of Cow Parsley averaged 46 inches tall, and of the flowering and fruiting Hogweed 52 inches). These Umbellifers constituted more than two-fifths of the vegetation, resulting in a larger proportion of broad-leaved plants in the total vegetation than usual. The lush vegetation of the control plots was fairly diverse, with about 23 species per plot (Table 1), but less so than in 1968 when the vegetation was shorter and smaller in total bulk. False Oat (Arrhenatherum elatius) was, as usual at this site, the major grass component.

The effects of maleic hydrazide

Areas sprayed with MH only developed at first a fairly short grassy sward with abundant Creeping Fescue (Festuca rubra) and Meadow Grass (Poa pratensis); the large tufted False Oat and to some extent Cocksfoot (Dactylis glomerata) were reduced. Although MH has limited herbicidal powers, Umbellifers were adversely affected and considerably reduced, even in the first year of spraying. Flowering of grasses was almost completely suppressed, and vegetative growth held substantially in check. After spray treatment for 3-4 years, False Oat became a minor component of the vegetation, Creeping Fescue increased further at the expense of Meadow Grass, and several low-growing dicotyledonous herbs became plentiful, notably Ribwort Plantain (Plantago lanceolata) and Crosswort (Galium cruciata), as well as Creeping Thistle (Cirsium arvense). In 1969, as shown in Table 1, Creeping Fescue and Plantain (which was very sparse in or absent from the other plots) dominated the vegetation, which strongly contrasted and was rather more diverse than that originally present. A number of low-growing annuals, e.g. Buxbaum's Speedwell (Veronica persica) and Chickweed (Stellaria media), invaded the sprayed areas, establishing in small bare pockets created by the spray treatment in the short vegetation.

The effects of 2,4-D

Repeated annual sprays of 2,4-D only resulted in the progressive reduction and extinction of broad-leaved plants and the development of a more uniform and shorter vegetation than that of the unsprayed plots.

Table 1

The effects of spray treatments on the composition of the vegetation of roadside verges at Bibury.

The figures give percentage relative bulk (average values) of the chief components of the vegetation in mid-July 1969, and are based on assessments of the whole plots. Verges treated with MH only and MH + 2,4-D were sprayed once annually from 1958 to the present, and with 2,4-D only from 1959 onwards.

Treatment	Control (unsprayed)	MH only	2,4-D only	MH + 2,4-D
Number of plots	8	2	2	6
Couch Grass (*Agropyron repens*)	3.4	7.5	8.8	2.8
False Oat (*Arrhenatherum elatius*)	10.0	2.6	4.3	0.5
Cocksfoot (*Dactylis glomerata*)	7.5	3.0	16.3	3.9
Creeping Fescue (*Festuca rubra*)	1.0	16.3	17.5	7.1
Meadow Grass (*Poa pratensis*)	5.8	8.8	36.3	75.0
All grasses	34.4	42.5	96.3	92.1
Cow Parsley (*Anthriscus sylvestris*)	18.8	0.1	0.1	0.1
Hogweed (*Heracleum sphondylium*)	23.1	1.3	0.1	0.1
Plantain (*Plantago lanceolata*)	0	22.5	0	0
All broad-leaved plants	65.6	57.5	3.7	7.9
Average number of species	22.8	26.0	12.5	13.7
Average height of vegetation (in.)	43.5	12.5	27.5	10.3

Dicotyledons resistant to 2,4-D such as the Field Scabious (Knautia arvensis) persisted, but grasses became very strong dominants. However, important gradual changes occurred over the years in the grass components; Meadow Grass and Creeping Fescue increased very substantially whereas False Oat was diminished (Table 1). Flowering of the grasses was somewhat reduced; this feature, coupled with the decline of False Oat and tall Umbellifers, which were almost eliminated, accounted to a large extent for the shorter vegetation.

The effects of MH combined with 2,4-D

When MH and 2,4-D were used together as a mixed spray, their effects were complementary. A very short and uniform grassy sward resulted, from which some dicotyledonous plants were completely eliminated; others, such as Hogweed and Cow Parsley, were reduced to negligible proportions. Good control was given of agricultural weeds such as Creeping Thistle, Sow Thistles (Sonchus spp.), Docks (Rumex spp.) and Stinging Nettle (Urtica dioica), as well as of annuals. Of the broad-leaved plants, only Bindweed (Convolvulus arvensis), which developed sufficiently late in the season to escape the major effects of the spray in spring, persisted in appreciable quantity. Spraying led to the progressive spread and overwhelming dominance of Meadow Grass, which constituted three-quarters of the vegetation in 1969 (Table 1), in some areas being almost the only component. Creeping Fescue, which like Meadow Grass had underground rhizomes, increased to some extent, but was usually of minor importance relative to the Meadow Grass which formed a thick mat. False Oat was reduced nearly to the point of extinction, being severely diminished even by the first spray treatment. Also adversely affected by the spray were Couch Grass (Agropyron repens), which has shown some decline in recent years, and Cocksfoot; the latter, however, often recovered from the effects of the spray and made appreciable growth towards the end of the season. Flowering was almost entirely suppressed, and the vegetation remained quite short throughout the year (it was less than one-quarter of the height of the vegetation of the untreated areas in July 1969).

Reversion of sprayed areas

Cessation of the MH only spray treatment led to gradual changes in the vegetation in the direction of its former composition. Loss of Creeping Fescue was to some extent paralleled by an increase in False Oat, and with the progressive re-establishment of tall vegetation, including large Umbellifers, many of the low-growing plants which colonized and became successful under the spray regime were suppressed or eliminated. In particular, considerable reduction in Plantain and Crosswort was evident. After reversion for seven years False Oat, Hogweed, and Cow Parsley made up over two-fifths of the bulk of the vegetation; in striking contrast were the MH-treated plots where these plants constituted only one-twentyfifth of the total in 1969 (Table 1). Most of the plants flowered well in the year spraying was stopped, but the

vegetation was somewhat shorter than that of unsprayed areas.

Cessation of spray treatment with combined MH + 2,4-D resulted in gradual reversion of the community strongly dominated by Meadow Grass, developed under this treatment, to a vegetation quite similar to that of the control plots. Meadow Grass and Creeping Fescue were progressively reduced to minor components (see Table 2), and False Oat increased to become the dominant grass. (In other reversion plots in previous years False Oat made up a larger proportion of the vegetation than that shown in Table 2 for the single reversion plot for 1969, for which the results are influenced by the extremely vigorous growth of the Umbellifers in 1969). The large changes in the grass components consequently involved a loss of the shorter, finer-leaved species and an increase in the taller, coarser forms. Dicotyledonous plants gradually re-established, some mainly from seed and some mainly by vegetative spread from adjoining areas. However, it was not until five years after spray treatment ceased that Hogweed and Cow Parsley became widespread once more, and even after eight years the vegetation of the reverted areas was somewhat less diverse than that of the control areas (Table 2). Apart from this feature, the vegetation of the reversion plots after five years was fairly similar to that formerly present. Many of the plants flowered quite freely in the year in which spraying was stopped and, as in the reversion plots of the MH only series, the height of the vegetation soon became similar to that of the unsprayed areas.

Effects of spray treatments in the first year after a period of reversion

Application of 2,4-D in September, 1968, and then of MH in mid-April, 1969, to plots previously sprayed with MH + 2,4-D followed by a 7-year reversion period resulted in a vegetation with grasses and broad-leaved plants in equal proportions in July, 1969 (Table 2). Comparison of the vegetation of these plots in 1969 with that in 1968, after a long period of reversion, shows that the increase of Meadow Grass was rapid and substantial, associated with some increase of Creeping Fescue. On the other hand, False Oat was appreciably reduced. The population of Umbellifers was very greatly affected, Cow Parsley almost to the point of extinction, but other broad-leaved plants persisted, the fairly diverse flora containing, for example, quantities of Goosegrass or Cleavers (Galium aparine) and Hedge Woundwort (Stachys sylvatica). The growth of the vegetation was considerably held in check (Table 2), and flowering was sparse.

Treatment with the combined spray materials, MH + 2,4-D, in mid-April, 1969 of plots previously sprayed with MH followed by a 7-year reversion period led to a great diminution of broad-leaved plants, some being eliminated altogether. Marked changes in the grasses also occurred. The most striking effects were the large increases in Meadow Grass and Creeping Fescue, and a very substantial decrease in False Oat (Table 2).

Table 2

The composition of the roadside vegetation at Bibury of a plot previously sprayed and allowed to revert, and of plots sprayed in the first year after a long period of reversion.

The figures give relative bulk (for details see Table 1) of the chief components of the vegetation in mid-July 1969.

Treatment	Control (unsprayed)	MH + 2,4-D previously; then reversion for 8 years	MH + 2,4-D previously; then reversion for 7 years; 2,4-D in mid-September 1968; MH in mid-April 1969	MH only previously; then reversion for 7 years; MH + 2,4-D in mid-April 1969
Number of plots	8	1	2	3
Couch Grass (*Agropyron repens*)	3.4	1.0	11.2	16.7
False Oat (*Arrhenatherum elatius*)	10.0	5.0	3.8	1.2
Cocksfoot (*Dactylis glomerata*)	7.5	2.5	5.5	5.8
Creeping Fescue (*Festuca rubra*)	1.0	0	5.0	10.8
Meadow Grass (*Poa pratensis*)	5.8	1.0	21.2	41.7
All grasses	34.4	15.0	50.0	85.0
Cow Parsley (*Anthriscus sylvestris*)	18.8	30.0	0.1	0.1
Hogweed (*Heracleum sphondylium*)	23.1	20.0	3.7	3.7
Goosegrass (*Galium aparine*)	1.6	1.0	10.5	1.7
Hedge Woundwort (Stachys sylvatica)	1.8	2.5	12.5	0.7
All broad-leaved plants	65.6	85.0	50.0	15.0
Average number of species	22.8	18	22.5	19.7
Average height of vegetation (in.)	43.5	42.0	13.5	13.7

The height of the vegetation was strongly controlled, and flowering of most plants much reduced, Meadow Grass being the least affected in this respect.

As previously noted, the assessments of the vegetation of the single reversion plot for 1969 are influenced by the extensive growth of Umbellifers that year, so that direct comparison of the vegetation of the sprayed reversion plots with this vegetation must be made with caution, especially in view of the small number of plots involved. However, only changes which are firmly based are indicated above; for example, even the limited records now available show unequivocally the marked increase in Meadow Grass during the first year of spray treatment of the reversion sites.

The effects of time of spray

To investigate the influence of the time of spraying with MH only and with MH + 2,4-D some plots were treated in the first week in April, some a fortnight later, and others a further two weeks later in early May. Only small effects of time of spraying were found with regard to the changes in composition of the vegetation brought about by the sprays. In all of the MH only plots Creeping Fescue increased markedly and False Oat declined. Similarly in areas treated with MH + 2,4-D the sequence of change was largely independent of time of spraying; in all the plots a pronounced increase of Meadow Grass was found, and also a decrease of False Oat.

The most obvious differences resulting from time of spray treatment were in the height of the vegetation (the average of several estimates of the general height of the top of the vegetation was taken); the differences depended appreciably on the season and weather conditions during spraying. Usually only little growth had occurred by the time of the earliest spray but, particularly in some seasons, substantial growth can have taken place by early May, the latest spraying date investigated. The effect of the spray was to hold the vegetation in check from the time of its application for a considerable period. Consequently by early June the height of the vegetation of the early sprayed plots was often only about 4 inches, compared with about 10 inches for the late sprayed plots, much of this growth having been made before spray application. Later in the season, differences in height evened out, because resumption of growth set in first in the early sprayed areas whilst the vegetation of the later sprayed plots was still kept substantially in check. In all of the spray treatments involving MH, irrespective of time of application, the average height of the vegetation was in most years 8 - 12 inches in mid-July, and some 12 - 14 inches at the end of the season (the vegetation of the control plots was more than double this height in September and, as shown in Tables 1 and 2, more than three times the height of the vegetation of the sprayed plots in July 1969).

The control of the vegetation of road verges by spray treatment

The use of chemical sprays to restrict theheight of roadside vegetation and to eliminate injurious weeds compares favourably with other methods of verge maintenance, all of which necessarily result in some departure from the original flora and fauna of the untreated verge. The widely used growth-retarder MH and selective herbicide 2,4-D are relatively non-toxic to animals, although the fauna is in time indirectly affected as a result of the changes in the vegetation brought about by spray treatment. Good control of plant growth on verges can be achieved by a single application of the combination MH + 2,4-D in spring (as indicated above, some flexibility in time of spraying is permissible). Generally treatment of a band 6 ft wide is quite adequate, although a greater width may be required on dangerous bends where vision is much restricted. Such treatment is more economic than management by cutting if cuts are made at frequent intervals, and especially if carrying is also required. If a very high standard of control of length of grass is needed throughout the year, a second spray of MH only may be applied 12-14 weeks later than the first application of the combined materials in the spring.

Conditions at the time of spraying influence its effectiveness. As the substances involved are absorbed by the plant largely through the shoot system, and especially by the leaves, penetration is most extensive in spring when new growth begins and young leaves unfold. A moderately humid atmosphere and moist soil favour absorption, but heavy rain tends to wash the spray materials off the plants. However, recent advances in formulation have led to the development of chemicals which are weatherproof to a considerable extent. Strong winds increase the hazards of drift, although the high volume application recommended minimizes this danger.

Verge treatment with MH + 2,4-D leads progressively, as indicated above, to a short grassy sward which is of pleasant appearance and in which the narrow-leaved rhizomatous Meadow Grass and Creeping Fescue are prominent, and the broader-leaved, larger tussock formers False Oat and Cocksfoot are diminished. Several factors may be involved in the differential susceptibility of the grasses to the spray materials. The greater sensitivity of the taller, tufted grasses may result partly from their tussock habit and wide leaves which catch and absorb the materials extensively and also partly from the greater exposure of buds to the spray as compared with those of species with rhizomes.

The action of MH is to check vegetative growth and to stop flowering, suppressing cell division at the growing points; grasses remain short and only rarely flower. The findings detailed above indicate that MH, used alone, leads at first to the development of a sward with much Creeping Fescue, the fine waxy leaves of which are not easily wetted. However, the combined spray (MH + 2,4-D) results in a vegetation strongly dominated

by Meadow Grass, which, with repeated spray treatment, continues to increase in abundance over a considerable number of years. There are indications that Creeping Fescue is more sensitive to 2,4-D than Meadow Grass, and the somewhat quicker recovery of the latter from the effects of the combined spray may promote its more rapid spread into bare areas resulting from the loss of dicotyledonous plants and the reduction of other grasses. The development, under the influence of MH + 2,4-D, of a short grassy turf, largely free from broad-leaved plants, and in which Meadow Grass and Creeping Fescue are abundant, is of widely spread occurrence in Great Britain (where both grasses are common and generally distributed) and also on the Continent; there the more drought-resistant Fescue may be present in some localities (e.g. in Belgium, Germany, Austria) in greater proportion than found at Bibury. Despite somewhat conflicting reports concerning the effects of MH on plots in Cambridgeshire compared to those at Bibury (Way, 1969), observations indicate that at the Cambridgeshire site, originally strongly dominated by False Oat, Creeping Fescue is now apparently increasing.

That a single spray with the combined materials MH + 2,4-D can have a very pronounced effect on the composition as well as the height and flowering of the vegetation in the first season is evident from the effects of spray treatment on the reversion plots. As a result of one spray application Meadow Grass made up more than two-fifths of the vegetation, and broad-leaved plants were reduced to about one-sixth of the total bulk, tall Umbellifers being especially affected. Spraying with MH only (after an autumn spray of 2,4-D) was equally effective in the first season in controlling growth in height and in preventing flowering of the vegetation of reversion plots whose composition before the application of the spray was almost indistinguishable from that of the original vegetation; however, with this treatment many broad-leaved plants persisted and grasses constituted only half of the bulk of the vegetation in 1969.

The ecological effects of spray treatment are of substantial interest. The roadsides and the diminishing hedgerows support characteristic assemblages of plants and animals which strongly merit conservation. For this reason the width of the sprayed verge should not be greater than that compatible with the need for visibility; then the original, usually more diverse, flora and fauna can persist in the unsprayed part of the verge immediately adjoining the hedge. Furthermore the gradation of height from the low treated sward to the tall vegetation of the ditch and hedgebank creates a range of conditions advantageous to some organisms. While the herbicidal action of MH is small, and MH alone can ultimately result in greater diversity of the roadside flora, 2,4-D and other selective herbicides such as MCPA and mecoprop adversely affect many dicotyledonous plants, some of which may be rarities. However, where a stretch of verge is known to support a population of a susceptible rare species special arrangements for preservation may be sought and other means

of verge maintenance than spraying adopted in the particular site.

Another important ecological consideration is the degree of persistence of the effects of spray treatment. The direct effect of MH and 2,4-D on growth and flowering is essentially for a single season, but the reversion of the vegetation to its original status is, like the changes in vegetation composition which arise from repeated spraying, spread over a number of years. A Bibury re-establishment of vegetation comparable with that originally present takes five or more years. The Meadow Grass sward, especially when pure and thick, which is gradually developed under the influence of MH + 2,4-D, is difficult for other species to invade, especially by those whose seed production is limited and germination poor. Quickest to re-establish are those plants, such as False Oat, which spread from the very small quantities which survive treatment.

Control of woody growth on verges is required from time to time. For this purpose the herbicide 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) is effective, and may be used as an emulsion containing two parts of 2,4,5-T to one part 2,4-D of low volatile ester. If bushes are cut during the winter, and the stumps treated with this brushwood spray in February, March or April, regrowth is prevented.

Acknowledgments

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THE IMPORTANCE OF ROAD VERGES IN A RURAL DISTRICT AREA

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Berwickshire is one of the truly rural areas in the United Kingdom with little or no industry. The entire county is designated as countryside under The Countryside (Scotland) Act, 1967, while about one-third of the area is designated of Great Landscape Value. It has a low spending road authority whose roads act as a corridor between Scotland and England. Large occupied estates abound whose owners operate a countryside policy on their land and, by their example, influence road verge maintenance to a considerable degree. Horse riding is common and the general motoring public readily accommodates horses and riders even on the busiest of roads.

The roadside verges may be defined as the area between the edge of the carriageway and the road boundary. The road boundary may consist of a wall, hedge, fence or ditch, or merely an imaginery line at a distance from the edge of the metalled road in uninclosed land. The road boundary on uninclosed land is often indefinite but in many cases, a roadside ditch, or an artifically formed mound exists and has been taken as the dividing line. The only legal assistance on this point is given on the formation of side ridges 12' 0" wide at the sides of any turnpike road.

The duties of a highway authority in Scotland are generally to provide a safe passage over their roads, including the verges, and also to cut weeds on the sides of the road, when inclosed, at a proper season of the year. Section 106 of the Turnpike Act of 1831 incorporated in Schedule C of the Roads and Bridges (Scotland) Act, 1878, specifically mentions inclosed lands; in the writer's experience, the position on uninclosed lands has never been the cause of complaint as the highway authority has powers under the Roads Improvement Act, 1925, to lay down and maintain grass verges and, in doing so, generally covers the position in respect of weeds.

The Weeds Act, 1959, (see p. 22, these proceedings) and the Seeds (Scotland) Regulations, 1961, list the injurious weeds which a land occupier may be compelled to prevent from spreading. While most of the weeds listed can be found in Scottish road verges, the writer cannot recall his attention being specifically directed to these regulations nor to any of the specific weeds mentioned. The local roadmen state that the commonest weeds on Border verges are the Cow Parsnip (Heracleum sphondylium), Willow Herb (Chamaenerion angustifolium) and Butterbur (Petasites sp.). The regular cutting of road verges, to include all growth, perhaps meets the requirements of the regulations.

As a background to a verge maintenance policy, it is of interest that, prior to 1939, the Berwickshire authority employed 100-140 men especially for grasscutting in addition to permanent staff of 50-60 men. In 1969, only 28 men were employed for varying periods, including 12 lengthsmen, who are still employed by many other Scottish Authorities.

In Scotland, there is generally a large variation in expenditure on trunk and principal roads, as compared with the Class II, Class III and Unclassified Roads and also on the district ways, which can be maintained by the District Councils and are generally right-of-ways. There is a considerable variation in verge maintenance from one class to another due to expenditure ceilings.

The expenditures per mile in Berwickshire for 1969 were as follows:

Trunk Roads: £42. 16. 0d. per mile of £12 per acre representing 3¾% of maintenance expenditure.

Principal Roads: £28. 18. 0d. per mile or £14 per acre representing 5% of maintenance expenditure.

Class II Roads: £12. 17. 0d. per mile or £7 per acre representing 4¼% of maintenance expenditure.

Class III and Unclassified Roads: £5 - £6 per mile or £4 per acre representing 4% of maintenance expenditure.

The figures for trunk and principal roads are influenced by the considerable amount of verge maintenance carried out as an aid to winter maintenance, explained later in the paper.

Taking expenditure ceilings into account, a verge maintenance policy must attempt to achieve the following objectives:

1. Verges should be sufficiently maintained to allow safe passage for pedestrians or riders off the carriageway.

2. To provide the maximum visibility to roadusers at bends and junctions.

3. To control the spread of injurious weeds, as far as these weeds affect the agriculturist and others.

4. When called upon, to remove scrub and other growths which may give harbourage for vermin.

5. To ensure that road sections prone to heavy snowdrifting are maintained in a condition which will give maximum efficiency in snow-clearing.

6. Preservation of uncommon plants by arrangement with the Scottish Wildlife Trust. (See Gilchrist, this symposium).

7. Preservation of amenity in terms of nature conservation, as far as this can be achieved consistently with legal liabilities and road safety considerations.

In practice, it is hardly possible to formulate a policy which will satisfy all the foregoing points, but the following local policy is thought to satisfy the majority of roadusers.

TRUNK AND PRINCIPAL ROADS - (139.75 miles)

On these roads, cutting is maintained throughout the season from April to September on verges and on areas created for sightlines on the inside of bends. Growth is kept down to approximately 6 inches, thereby encouraging walkers and riders to keep the carriageway lanes clear. Slopes of cuttings are only cut on the lower 6' 0", again for sightline purposes, the remainder is left uncut together with the slopes of embankments on straights and the outside of bends. To control tall weeds, chemical treatment is used on slopes of embankments on the inside of bends, these areas being the only places where weedkillers are used in the county, outwith the Burghs and Villages.

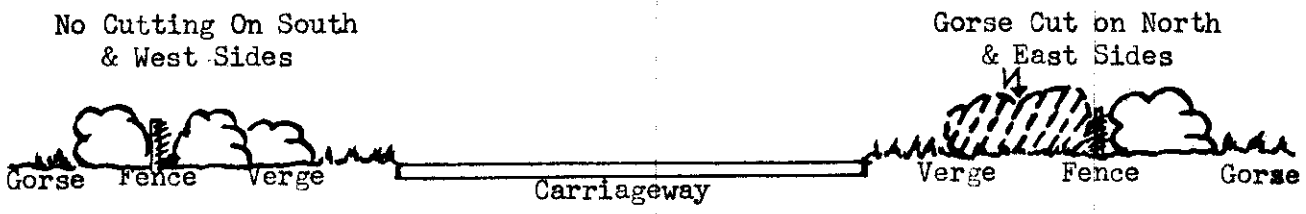
In all other places, the standard 12' 0" minimum width verge is the objective on these roads, crossfalled where necessary to meet snow conditions and actively maintained.

The Council are constantly criticised for control of whin or gorse growths on the sides of these roads because, in Scotland, these shrubs have some of the earliest blooms, particularly on hill ground, and present an attractive spectacle early in the spring. Figure 1 shows the work which is considered essential, if snowplough teams are to open blocked roads timeously. It should be noted that no cutting is done on the south or west side of the roads.

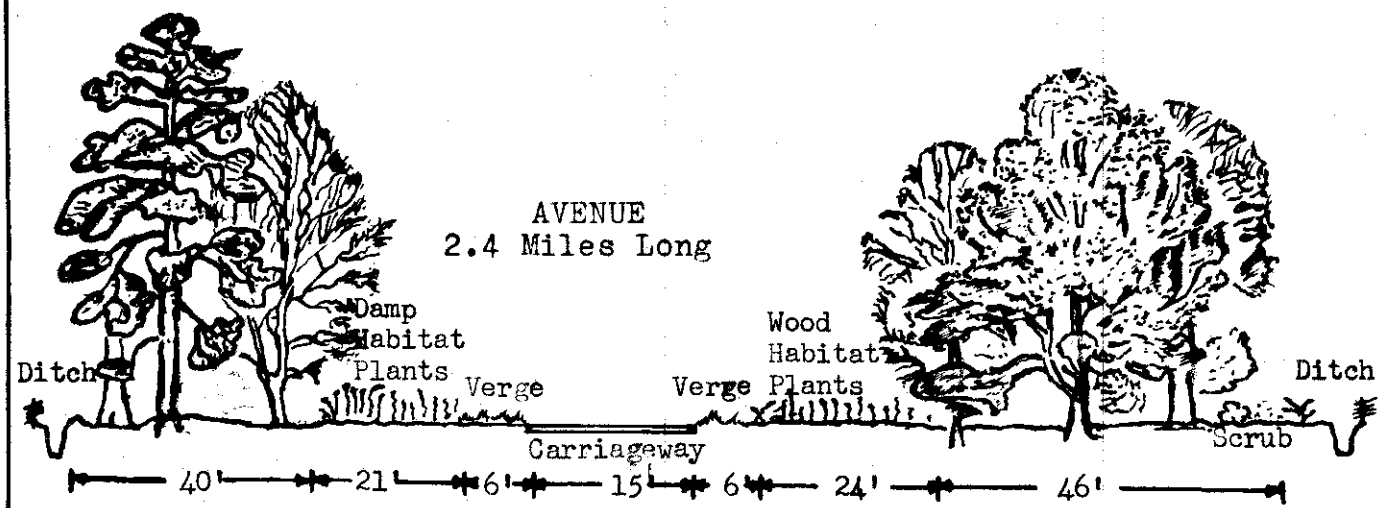
The pressure from the majority of roadusers leaves the road authority little choice in the maintenance of verges on trunk and principal roads, and inducements to nature lovers to stop must be restricted to the larger laybys and redundant sections of trunk roads, where full consideration can be given to conservation.

NON-PRINCIPAL ROADS, INCLUDING CLASS II, CLASS III AND UNCLASSIFIED ROADS - (466.37 miles)

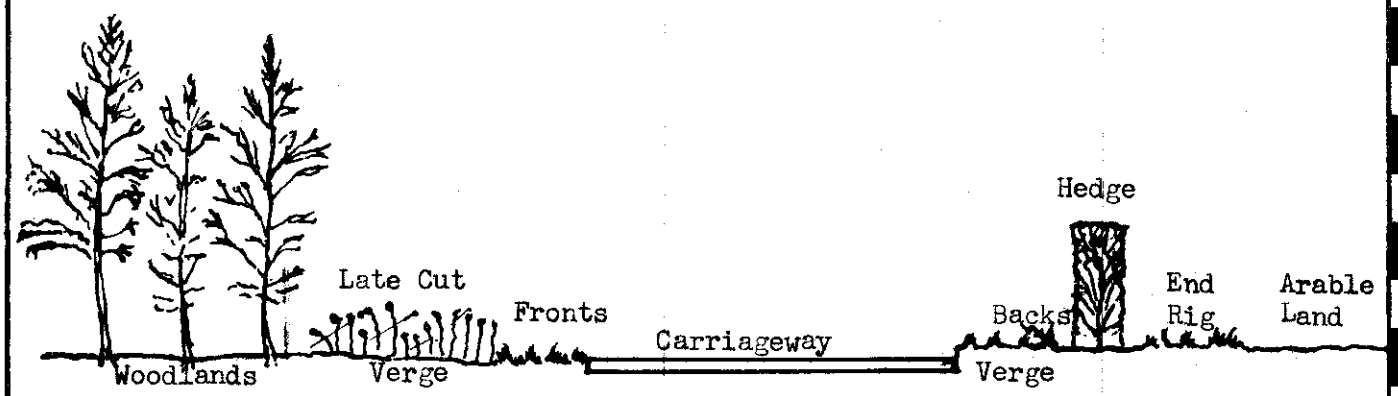
On the lesser roads in Scotland, a different policy is possible and indeed, the scale of permissible expenditure demands it. Selective treatment includes the following items.



WINTER MAINTENANCE VERGE CUTTING
Figure No. 1



MELLERSTAIN ENTRIES C.40
Figure No. 2



UNCLASSIFIED ROAD U.17/12
Figure No. 3

1. Safeguarding of uncommon plants by arrangements with local representatives of the Scottish Wildlife Trust, an agreement arising from a paper produced by the Trust for the County Surveyor's Society in 1967. In this work, locations of plants are especially marked and road staff instructed that the areas enclosed by the markers are to be left uncut. Any maintenance of these areas has been done by the Trust's representatives. The following is the list of plants which have been marked:

   Lysimachia nummularia - Creeping Jenny.
   Geranium pratense - Meadow Cranesbill.
   Rosa arvensis - Field Rose.
   Polygonum bistorta - Bistort or Snakeweed.
   Senecio erucifolius - Hoary Ragwort.
   Cicerbita macrophylla - Blue Sow Thistle.
   Plantago media - Hoary Plantain.
   Galium boreale - Northern Bedstraw.
   Sedum telephium - Orpine.
   Dianthus deltoides - Maiden Pink.
   Agrimonia eupatoria - Agrimony.
   Aremonia agrimonoides.

2. Adoption of a form of the 3 tier method of verge cutting, whereby only the "fronts" are cut in the June - August period, the remainder being cut later in the year or cut only once in 2 or 3 years depending on the use of land adjoining the road. The safeguarding of young birds may entail leaving the fronts also until early July when this can be done with safety.

3. Selective cutting of areas containing weeds injurious to agriculture and which have been the basis of complaints by farmers. In this connection, it has been noted that farmers do extend their field sprays to adjoining verges, probably having in mind the probable benefit to crop production.

4. Selective cutting of areas badly overgrown with brambles, willow herb or similar growths which tend to form harbourage for vermin, or which walkers and riders cannot readily negotiate or as a result of which are liable to injury, if forced off the carriageway or "fronts" of verges.

A verges policy based on the above considerations can give sections of roadsides of high amenity similar to that depicted in Figure 2, which shows a cross section of one of the first tree lined avenues established in Scotland at Mellerstain Estate. In this instance planting, natural and maintained verges combine to meet all rural considerations. Figure 3 shows a typical road verge on many of the lesser roads in Berwickshire.

Generally, the sowing of new grass verges is worthy of more consideration. At the London Symposium (Way, 1969), the M.O.T. Specification, which includes over 50% of perennial rye grass, was discussed, as to whether the specification should be changed. In the Countryside Commission's publication on Picnic Sites (Anon, 1969), Appendix 11 gives a high percentage of rye grass to obtain quick cover on new areas, although alternative specifications, omitting rye grass, are also included. In this publication, it is stated that the species which is most resistant to wear is the Creeping Red Fescue. It is slow to develop and, if quick cover is desired, it can be mixed with Perennial Rye grass. Over a few years, the latter will disappear as the Fescue becomes dominant, and this may hold good in many areas. Successful experiments increasing the percentage of clover have been carried out in Berwickshire, the result being a short growing verge of some character.

To investigate approximately what native grasses are to be found on verges in Berwickshire, the writer is indebted to Mr. W.A. Buckpitt and Dr. Herriot of the East of Scotland College of Agriculture for the following analysis of turf from a verge on a Class 1 Road, which was not sown down in living memory.

Red Fescue	28%
Common Bent grass	17%
Smooth Stalked Meadow grass	10%
Yorkshire Fog	6%
White Clover	6%
Crested Dogs Tail	5%
Cocksfoot	5%
Meadow Fescue	A trace
Moss	5%
Bare Ground	14%

This verge has always been cut and, as far as it is known, no chemical sprays have been used on the section by the road authority. Perhaps the foregoing analysis supports the view of the Countryside Commission's publication quoted above.

The success or otherwise of fitting the road into the landscape depends considerably on the following items:

1. Road verges, including slopes of cuttings and embankments.

2. Road boundaries, either of fencing or hedge.

3. The degree of planting for shelter and/or amenity.

The Border area, with its high scenic and other natural values, owes much to those who planted the tree lined avenues, shelter belts and screens after the Napoleonic Wars. Sub-areas, such as Scott's View, Dryburgh Abbey, etc., within the designated areas of Great Landscape Value, have not been disturbed by other than very local road improvements, generally for parking accommodation.

The requirements of the government department and the road authority that only the minimum land should be acquired for road improvement has resulted in a certain loss of amenity with the new road schemes, which have fortunately fallen outwith the designated areas. It has also been difficult to acquire land for road shelter belts for winter maintenance purposes, while the small amount of planting carried out for amenity purposes has been done by authorities other than the road authority.

Despite the requirements mentioned above, it has been possible in co-operation with landowners, to flatten slopes of cuttings or embankments by agreement, leaving these areas in their ownership and erecting fences at the back of verges to give a more uniform line and also some definition to the driver of the effective width of the road. Despite the fact that these arrangements cost the road authority more by way of temporary fencing, it is felt that the owner can make the slopes of cuttings or embankments correspond with the adjoining fields.

Road boundaries are important and the Berwickshire authority does insist on drystone or masonry walling where necessary, timber stob and wire fencing to the exclusion of concrete posts, while there is also a large mileage of beech and thorn hedging.

Hedging plays an important part in verge policy, particularly as the maintenance is not the responsibility of the highway authority, although the latter has powers to order pruning and trimming at particular times of the year. It is not generally known that hedges need only be cut to a height of 6 feet above ground level and, of course, this height does not aid visibility to roadusers. Many agriculturists demand that roadside weeds be cut right up to the roots of the hedges and only the lengthsmen can scythe these "backs". Unfortunately, mechanical hedge-cutting is taking the place of the hedger, whose craft they cannot match. The danger to roadusers by thorns flung on the carriageway by these machines cannot be overstressed, while the practice in some areas of cutting the tops of the hedges obliquely, when the front is possibly 6 feet and the back 8-9 feet high, does not lend, in the writer's opinion, to good countryside practice.

The degree of public and private planting is of great significance for amenity and winter maintenance purposes. Forestry is a main industry in the Borders and for some years there has been a need for comprehensive planning of planting in the vicinity of trunk and principal roads. The importance of road shelter belts for winter road maintenance purposes cannot be overstressed, as the first experimental belts planted on Soutra Hill Trunk Road A.68 at elevations above 1,000 feet O.D. have now proved their worth. Apart from preventing a build up of snow on the carriageway, these belts guarantee acceptable visibility in drifting conditions thus enabling the average driver to cope. Generally, shelter belts must be located on the north and east of the road in the east of the country, as

planting on the south and west sides, unless taken 90-100 feet from the road boundary, has been found to have an adverse effect. The Canadians report that the first 3 or 4 rows of trees set 80 feet to 100 feet from the road form the shelter belt, the remainder to the roadside can be planted for amenity purposes.

Amenity planting on rural road verges must be discouraged as these verges must be reserved for the emergency or incidental use of vehicles, while the presence of trees would greatly increase the cost of maintenance and disturb, by their roots, the services of statutory undertakers, which exist in most roadsides. Some such undertakers desire a clearance of 20 feet from any proposed tree position to their services.

It is the writer's opinion that in areas of Great Landscape Value, Land Use and Maintenance Schemes such as prepared for the 477 mile Blue Ridge Parkway in America in 1935 (Disque, 1959), and followed there ever since, should be formulated by highway authorities and landowners, and by the nature conservation bodies together with landscape architects, even on a small scale for sub-areas such as Scott's View and other areas of special interest. Some code of practice is essential.

The definition of countryside, includes small burghs and villages up to 5,000 in population. It is, therefore, proper that this paper should make reference to these built-up areas and the efforts made in villages to fit in with the countryside.

Interest in Berwickshire has been fostered by the 'Britain in Bloom' competition: commencing with one voluntary village scheme in 1968, there are now possibly 9 areas with planting or amenity schemes for 1970. While these schemes tend more to suburbia than otherwise, there is certainly scope for the Scottish Wildlife Trust in advising on these very local efforts.

Chemical spraying is used in the villages on road channels, heel of footpaths and grass areas. The Berwickshire authority do not readily accept chemical spraying and its use is only permitted where complete eradication of growth is necessary.

In conclusion, it is the writer's contention that a road is as good as its verges and that a good verge management policy must be supported by proper care of hedges and a suitable private and public planting policy.

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GRASS VERGES IN BUILT - UP AREAS

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1. INTRODUCTION

The peripheral area around any large city has over the last three or four decades, become the dormitory area for a large proportion of city workers and this tremendous building boom has necessitated the construction of new or improved Trunk and Principal roads together with new district distributor roads and finally the local distributor and access roads. Over these thirty or forty years, a gradual evolution of design standards has resulted in a multitude of verge widths, and almost as many methods of verge treatment, varying from grass to green painted asphalt both of which frequently have an equal quantity of dandelion or docks growing on them. The modern method of laying verges with paving setts or slabs relieved by the forming of areas planted with trees or shrubs has from the maintenance point of view a lot to recommend it especially near shopping developments, schools, hotels or places which attract a high volume of pedestrian traffic.

In rural areas most grass verges are long established and composed of indigenous grasses and herbaceous plants, whereas in built-up areas most verges are relatively new and are composed of a varied selection of grass mixtures all of which seem to contain a large percentage of clover, and into which has invaded such plants as buttercup, plantain and daisy. This type of vegetation is quite acceptable on a highway margin provided the verge remains aesthetically pleasing, is cut at reasonable intervals and that measures are taken to prevent the creeping plants from obscuring the kerbs.

The purpose of the grass verge on all-purpose roads is stated in "Roads in Urban Areas" (Anon, 1966), to be "to increase separation of vehicles from pedestrians" and "to improve the appearance of the road". In addition the verge can accommodate highway drainage and cables, statutory underground services and the wide selection of street furniture which the highway engineer now erects for street lighting and traffic restriction or direction.

The construction of Urban Motorways has introduced a new type of grass verge which does not fulfil the functions normal to verges, in that there are no pedestrians nor statutory underground services, however the grass verge here acts as a barrier between traffic and property, provides an area for landscape treatment and accommodates the slopes of cuttings and bankings. The areas covered by Motorway verges is substantially

greater than on other classes of highways and this creates unusual problems for the maintenance engineer in that slopes can be up to twenty yards from the hard shoulder to the highway boundary and can be inclined as steeply as 34^{0} to the horizontal.

The magnitude of the task of cutting the grass on a motorway can be assessed from the fact that an average of 40% of the area of land purchased for Motorway construction is sown down in grass and it is not unusual for twenty acres of ground to be purchased per mile of three lane dual carriageway motorway. In addition to the above area, there must be added the areas at interchanges which can cover as much as $12\frac{1}{2}$ acres.

2. DESIGN OF VERGES

The design criteria for grass verges given in the manual "Roads in Urban Areas" is very brief and is as follows:- "Wider verges may be grassed provided their width is sufficient for the establishment and maintenance of grass cover. Grass verges may require a crossfall of about 1 in 20 for adequate drainage: they should be suitably levelled and trimmed and should be free from concealed grips and similar hazards," and at another point it is stated that - "Variation of the verge width may sometimes give scope for the planting of trees and shrubs but care should be taken to prevent or discourage the use of the verge by pedestrians, and it should never be so narrow as to make maintenance difficult."

The briefness of the foregoing criteria allows the highway engineer plenty of scope provided he can obtain at the design stage, land to provide adequate verge widths. In order to justify the purchase of this additional and in many cases expensive land economic as well as aesthetic advantages must be shown. It is very difficult to place a value on aesthetics at any time, therefore by utilising the verge area for the siting of bus stopping-places, street furniture and public utilitys' apparatus an economic justification can be achieved.

At present one of the most detrimental ancilliary functions of the public highway is its use as a channel for all public utility services. The cost to the nation of breaking up existing paved highway surfaces together with the extremely high cost of reinstatement, added to the cost of traffic delay is of such magnitude that if verge widths of eight to ten feet could be provided to accommodate the pipes and cables of our civilization, the cost of the land could be recouped in less than thirty years. During this period the benefit of having a buffer area of grass verge would have been obtained at a cost of the maintenance work carried out on the verges. This is surely a small price for amenity and added safety.

In the past, grass verges have been used in urban areas as a barrier to discourage pedestrians from crossing carriageways at points where there is a potential danger such as at intersections and junctions, but it has been consistently observed that pedestrians will take the shortest distance across a junction and in the process destroy part of the grass verge. This tendency has led to the replacement of entire grass verges in areas of high pedestrian traffic density by a paved surface such as concrete or macadam. It has been found however that the provision of a relatively narrow surfaced access over the verge has solved this problem and the grass verge can be retained and still fulfil its aesthetic function despite a slight reduction in area.

The planting of trees in the verges of highways should be encouraged provided they are sited at a safe distance from the carriageway. A safe distance is arbitary, but there are indications that a minimum distance of five metres could be incorporated in future Highway legislation.

In many counties in Scotland increasing attention is being paid to tree planting on all purpose roads and to full scale landscaping of motorways, picnic areas and rural parking areas. In the past the planting and maintenance of trees and shrubs was not included in the normal "Roadman's" field of duties which meant that specialist employees were required to carry out this type of work and it was unusual to find these specialists in a Highways organisation. However a recent re-evaluation of the range of roadman's duties has included in them "the planting, supporting and general maintenance of trees and hedges" with the result that the Highways Authorities can now train present employees in these skills without causing labour relations problems. I have no doubt that this change will lead to a more active highway landscaping policy.

3. THE ESTABLISHMENT OF VERGES

Amongst the many methods of establishing grass verges, the most traditional is fully specified in the Ministry of Transport's "Specification for Road and Bridge Works" (Anon, 1969), and for those who are not familiar with this document a brief description is as follows:- "All surfaces to be grassed should be reduced to a tilth and the larger stones removed before fertilising with a specified mixture at a rate of not less than 1 cwt. to 800 square yards. Grass seed to specification shall be evenly distributed at rates of not less than 1 lb. to 90 square yards on verges and central reserves and 1 lb. to 60 square yards on side slopes."

The method described above should give a reasonable grass verge and although it suffered some criticism at the London Symposium (Way, 1969), the results seen in Central Scotland do not justify this criticism. The only alterations the writer recommends is that a mixture containing

a larger proportion of short growing grasses be sown on verges and central reserves at a heavier rate of spread, say up to 1 lb. to 40 square yards. This heavier coverage would result in a denser turf which would initially be easier to cut with reciprocating knife or flail mowers and would wear better under traffic. The sowing of side slopes using the "Ministry" specification appears to give acceptable results, but it may be said at this point, that the writer has not yet found any resident engineer who has actually carried out any tests to prove that the specified mixtures are being used.

In Scotland, most of the Motorways have been constructed in the Central belt with materials such as burnt shale and pulverised fly ash being used for upfill and these materials have presented certain difficulties in grassing and landscaping. Usually topsoil has been imported to cover this material and so provide an adequate grass seed bed but in other cases hydraulic seeding has been successfully employed. In general this method consists of incorporating the specified grass seed and fertilizer in an organic mulch which is sprayed on the surface at a rate of approximately 15 cwt. per acre. The ease of application and the fact that the soil need not be dry when the application is carried out, commends this method to Contractors, but it should be pointed out that in most instances, kerbs, signs, fence posts and lamp standards have to be cleaned after the process has been completed. "Hydra seeding" is being used in all types of locations varying from narrow grass margins on all purpose roads to large grassed areas on motorway interchanges where seeds of shrubs such as broom and gorse can be included in the specification.

Where grassed areas have to be established in areas of heavy pedestrian traffic, it is always advisable to erect temporary fencing such as chest-pale so that the grass is given protection from pedestrians and domestic animals. It is also advisable to vary the "Ministry" specification to a sports ground type mixture sown at 1 lb. to 30 square yards in accordance with the Recommendations for General Landscape Operations B.S. 4428: 1969.

4. MAINTENANCE OF VERGES

The cost of maintaining grass verges does not form a substantial part of the highway maintenance bill, and mainly consists of cutting grass, chemical control of grass and weeds, and the pruning of trees and hedges.

The cutting of verges is carried out by:-

(a) Hand cutting - This method is only used where it is impossible or uneconomic to cut by machine and is seldom used due to the difficulty of recruiting men who can use a scythe.

(b) Pedestrian operated machines - In built-up areas, the use of rotating blade and flail mowers has proved to be very effective especially if each operator can be allocated a definite district so that he can take a pride in it and his performance can be measured.

(c) Tractor mounted machines - For large grass area tractor mounted flail rotating blade or reciprocating blade mowers are normally used. There is no doubt that the reciprocating blade mower gives the highest output, but the flail mower can deal with more rugged ground while the rotating blade mower gives a compromise between the other two machines.

Few Highway Authorities attempt or wish to achieve a lawn type finish and the use of a cylinder type mower is not common. The frequency of cutting depends on the purpose of the grassed area, the weather and the type of grass. However in general, verges in built-up areas require cutting every three or four weeks commencing in mid May. On Motorways, the cutting of verges should be carried out at four to six week intervals with the first cut in late May and the last cut in October after the growing season is finished, while bankings require only one or at most two cuts each season.

The use of chemicals on grass verges is at the moment mainly restricted to total herbicides to prevent the growth of grass and weeds over kerbs, through paved surfaces or around street furniture where mechanical cutting is difficult. The use of simazine based herbicides has the advantage of being effective for twelve months even if applied in January or February and it prevents grass or weeds growing beyond seedling stage, thus eliminating the unsightly mass of dead plants. The use of selective weed killers and growth retardants is not common on highway verges although if an effective, reliable and cheap growth retardant could be found, its use could become widespread.

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ON THE VERGE OF SOME PROBLEMS

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1. Introduction

The stated aim of this symposium is to discuss the importance of road verges for amenity and wildlife conservation in relation to verge management and maintenance of the highway. I believe actual discussions will take us beyond the verge to the wider subject of roads in the landscape and, in writing the following contribution, I have had to assume that a broader approach is permissible.

2. The Countryside Commission for Scotland and the Countryside (Scotland) Act, 1967.

The Commission was established by the Countryside (Scotland) Act, 1967 to exercise the following functions:

> "The provision, development and improvement of facilities for the enjoyment of the Scottish countryside and the conservation of the natural beauty and amenity thereof."

Under an interpretative section (78), conservation of natural beauty is defined as including conservation of features of geological or physiographical interest and flora and fauna, thereby widening the Commission's interest to include the whole of the environment. An element of hard reality is introduced by section 1(2), enjoining the Commission to have regard to the need for the development of recreational and tourist facilities and for the balanced economic and social development of the countryside.

Under section 3, the Commission is charged with the duty of keeping under review all matters relating to its functions (as stated above), to consult with local planning authorities and other bodies as appropriate and to advise the Secretary of State on matters which he chooses to refer to the Commission or vice versa. Under section 8, the Commission has advisory duties specifically in relation to any matter arising under the Planning Act, which affects land in the countryside. This section is important because it is under what we call, domestically, "section 8 consultations" that most discussions about roads take place.

3. Countryside Act Grants

Several other sections of the 1967 Act are relevant to the symposium

theme. Under section 67, the Secretary of State is empowered to make grants to local authorities not exceeding 75% of the total cost, in respect of expenditure connected with the exercise of powers conferred on authorities by that Act and by certain other acts. Thus, local authorities' plans for "countryside projects" such as country parks, picnic sites, viewpoints and landscaping can be supported in this way by the Exchequer.

Section 7 is similarly concerned with payment of grant. Under this section, however, the recipients are persons other than public bodies and payment is made by the Commission rather than by the Secretary of State. Furthermore, under section 7, there are almost no constraints on subjects which could in theory attract grant ("any project conducive to any purposes of this Act"), except for the important condition that it must be "preferable that the project should be carried out by a person other than a public body". However, because of the current economic climate, hardly any funds at all have been made available for the Commission to use under section 7 and we generally tend to steer schemes for roadside facilities towards public rather than private bodies.

Work under sections 67 and 7 happens to be a major part of my duties as an employee of the Commission. Their position on section 67 is to advise the Secretary of State on the suitability of projects and the priority to be accorded to them, as there is never enough money available to meet all demands. The advisory role of the Commission is strengthened by para. 14 of Scottish Development Department Memorandum No. 72/1969 ("Explanatory Memorandum on Grants to Local Authorities"). On section 7 grants, the Commission may decide themselves on the projects to be supported, but actual grant needs the covering authority of central government.

4. The Commission and Roadside Verges

At present, the Commission has no policy for roadside verges. My guess - no more than that - is that a policy on this subject is never likely to be formulated; government bodies do not readily define policies on parts of the environment unless they have some specifically enacted responsibility for their care. This lack of defined policy has nothing to do with amount of interest. The Commission is certainly interested in road verges as part of the amenity of highways in general and eventually it might promote a publication on verges recommending management standards. Such a publication would probably appear as part of a series concerning facilities for the enjoyment of the countryside and matters arising under the Planning Acts which were frequently the subject of "Section 8 Consultations". I think it unlikely, however, that a publication specifically on roadside verges would see the light of day for many years. In relation to the size of Scotland and the range of duties

falling to the Commission, its staff is still small and it will be a long time before verges command anyone's attention except as part of wider problems. Some possible examples of wider problems are outlined in the following sections.

5. "Section 8 Consultations"

Under administrative arrangements flowing from section 8 of the Act, the Commission is to be consulted by the Scottish Development Department on all new motorways and on improvements to class 1 trunk roads. We have an advisory role on landscaping, and in this respect our responsibilities are somewhat similar to those of the Roads Advisory Committee to the Ministry of Transport Committee in England and Wales. In these consultations the Commission's role is to ensure that the Secretary of State is apprised of any proposed developments inimical to the public's enjoyment of the countryside or to the conservation of natural beauty, and to propose alternatives which, in the Commission's view, have more fitting regard to these factors. In practice and in company with most bodies having a constraining role, the main difficulty about this procedure relates to timing: often the Commission's view is sought only after much work has already been done by expensive computers on route selection and so forth. The long-term importance of this point may depend on particular cases; where new or improved road proposals traverse areas of high landscape value - e.g. the A82 on the west side of Loch Lomond - it is important that the Commission co-operates in the whole design process. Although one may be optimistic that this difficulty will be overcome, financial constraints on proposals for alignments more sympathetic to countryside amenity will continue to arise. The important point here is that the Commission, no less than the road engineer, must have regard to these financial constraints because we too are required to consider balanced economic development.

6. Liaison and Landscaping

In the consultative process it is always interesting to reflect on how each side of the table - as it were - comes to hold particular positions resulting from their original briefs. Regarding road verges, for example, no-one needs to be told that verges have a role to play in amenity nor that, because of increases in tourism and car ownership, verges are important places for visitors to stop. Road engineers are well aware that construction of new roads provides other opportunities than just that of creating a road. Each "side" has to delve beyond these superficialities to understand something of the deeper problems, motivations and restraints placed upon the other: a human factor not easily achieved at any level of government.

One recalls attending a meeting to discuss landscaping of a motorway

where the proposed centre line had raised no objections when announced a decade earlier, before most of us had begun to conceive the impact motorways could have in the landscape. Some had come to the meeting to hear how landscaping would hide the new monster, others to explain how her beautifully curving form would be girdled to enhance touring over a smooth surface. Final responsibility, however, related to whole schemes: both the visual corridor from within the highway and its appearance from without. It is not right that we object when new roads take up too much ground yet not allow the landscape architect enough room for manoeuvre.

7. Roadside Facilities

In planning for and in providing roadside facilities, one needs to consider (i) what to provide and where, (ii) what further facilities may be needed because provision of first phase works may generate greater demand, and (iii) what effects the provision of facilities may have on the peripheral natural, agricultural and forestry resources of the area around the highway. Solutions to the problem of where to provide new facilities may begin by traffic-flow surveys, priority being assigned to heavily used roads. There will be constraints: many seemingly good schemes have been stillborn because access onto the highway was deemed dangerous. Questions of ownership, especially in crofting counties, can result in extraordinary site selections judged by other criteria. Types of facilities, invoking questions of function, will include laybys, picnic sites, viewpoints, short walks, explanatory notices, touring caravan sites, cafes for tourists and heavy transport drivers, public conveniences, litter bins, litter collection services and so on. The verge may allow space for the whole of the required provision, mostly it is just one element in the total equation.

Many types of roadside facility can now attract 75% grant under section 67 of the Countryside Act. Here is a new opportunity to plan and create facilities that relate to car-borne visitors to the countryside. I know, however, that it is going to take many years and much hard-won experience before the Commission and all local authorities are equally proud of their achievements. We in the Commission are profoundly aware of the difficulties under which many local authorities have to work. As fiscal agents, we take seriously our dual roles of, on the one hand, not recommending grant on projects of a poor standard and, on the other hand, of not introducing niggling criticisms over every detail.

8. Other Considerations

Finally, here is a miscellany of further thoughts! Most of our Scottish road verges, hedges and hedgerow timber are little more than one or rarely two centuries old. Therefore, the conservation of verges -

as the representatives of some of the last vestiges of grassland floras - is probably not as important an aspect of roadside verge management as it is in lowland England. It seems to me also that there is not yet much evidence for being concerned about the loss of attractive road verges where, say, a succession of Umbellifers, Gereniums, Mallows and other wayside flowering plants have been eradicated due to the use of new forms of management alone. Certainly during the last decade, one has seen increasingly the use of the mechanical flail, but it does not yet appear to have had a serious detrimental effect on the visual appearance of roadsides other than in places where the needs of road safety were paramount. Indeed, I am aware of only one source of major complaint; this is the use of herbicides on rank vegetation in high summer, with appalling visual results and little practical benefit. In some fine landscapes herbicides are used to reduce fire hazard to neighbouring commercial forestry; a less visually harmful method must be found.

More care, too, should be taken over the creation of new verges especially where they result from road-widening operations and realignment schemes in Highland counties. It is in these situations where the major challenges for research, landscaping expertise and wise expenditure occur in Scotland. Whereas the verdant colours of, for example, hydromatic seeding will often readily tone in with surrounding landscape of the Borders and Central Lowlands, they may jar dreadfully against the richer tones of peat, moss, heather and bracken in a Highland glen.

In much of Scotland, replacement planting of roadside trees on established roads appears to be rare and one fears that many roadsides may soon look rather ragged if the apparent present general lack of roadside timber management continues. Wind in Scotland is particularly destructive to roadside planting. Its damaging effect is made more severe by clear-felling of nearby woods - for replanting with commercial timber - thus exposing roadside trees to wind forces of unaccustomed strength. The storms of 14/15th January 1968 were especially destructive to woodlands throughout central Scotland and, whereas replacement planting of economic forests has gone on apace, future generations may never see again roadside beeches and other hardwoods similar to some of the fine specimens that graced the countryside before that storm. Personally I would like to see section 67 used more often as a stimulant to replacement planting. It has been so used once, in Berwickshire, and indirectly elsewhere in connection with the excellent "Drive" magazine's "Plant a Tree" campaign.

The increasing use of salt on roads is another factor creating new interactions at the verge and possibly demanding new solutions. The symposium should be interested to learn whether Dr. Ranwell (1969) has anything further to report since last year. My main impression of the harmful effect of salt on verges is that it makes them look horrid by

producing a blackened strip, mostly along trunk roads and motorways. But perhaps the blackened vegetation is caused more by splashing with dirt and diesel oil than by salt.

9. Conclusion

Roadside verges are of interest to the Commission mainly because they are one of a number of wider problems related to highways in the landscape. The Commission has an advisory and consultative role in which it shares with others the task of finding balanced solutions to these problems. Furthermore, in as much as payment of grant to the public and private sectors may be part of the solution-finding process, the Commission also acts as a fiscal agent. In so doing and jointly with everyone else concerned, the care of roadside verges will not be overlooked.

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